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ABSTRACT

This document contains the text of three days of hearings before the United States House of Representatives Subcommittee on Science, Research, and Technology. The hearings were held to consider the role of science and engineering in world competitiveness, particularly with regard to the United States' nonmetric posture in a metric world. Testimony is included from: (1) The Honorable Don Ritter (U.S. Representative from Pennsylvania); (2) Dr. Lewis Branscomb (Harvard University); (3) Dr. Gordon Millar (National Academy of Science); (4) Helen Davis (American Society of Testing and Materials); (5) Daniel DeSimone (American Association of Engineering Societies); (6) Kenyon Taylor (North American Tool Company); (7) Frank Feigin (Digital Equipment Corporation); (8) Douglas Riggs (Department of Commerce); (9) Dr. Allen B. Rosenstein (University of California at Los Angeles); (10) Stanley Winkleman (Stanley Winkleman Associates); (11) Dr. Russell Drew (Institute of Electrical and Electronic Engineers); (12) Dr. Ronald L. Kerber (Department of Defense); (13) Larry Sumney (Semiconductor Research Corporation); (14) Charles E. Sporck (National Semiconductor Corporation); (15) Charles H. Ferguson (Massachusetts Institute of Technology); (16) Dr. William R. Graham (Science Adviser to the President); (17) J. Michael Farrell (Department of Energy); (18) Richard B. Geltman (National Governors' Association); (19) Frank H. T. Rhodes (Cornell University); (20) George H. Dummer (Massachusetts Institute of Technology); and (21) William Carpenter (Martin Marietta Energy System, Inc.). (TW)

THE ROLE OF SCIENCE AND TECHNOLOGY IN COMPETITIVENESS

ED289733

HEARINGS

BEFORE THE

SUBCOMMITTEE ON
SCIENCE, RESEARCH AND TECHNOLOGY

OF THE

COMMITTEE ON
SCIENCE, SPACE, AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

ONE HUNDREDTH CONGRESS

FIRST SESSION

APRIL 28, 29, 30, 1987

[No. 22]

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*Ranking Republican Member.
**Resigned February 19, 1987 (H. Res. 89).
***Elected March 30, 1987 (H. Res. 133).
****Ex-Officio, voting member.

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THE ROLE OF SCIENCE AND TECHNOLOGY IN COMPETITIVENESS

TUESDAY, APRIL 28, 1987

House of Representatives,
Committee on Science, Space, and Technology,
Subcommittee on Science, Research and Technology,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:36 a.m., in room 2325, Rayburn House Office Building, Hon. Doug Walgren (chairman of the subcommittee) presiding.

Mr. **Walgren.** Let us begin. The committee now begins three days of hearings looking at the role of science and technology in competitiveness. The first day of hearings will focus on the contribution of the National Bureau of Standards to competitiveness and how we as the only nonmetric industrial nation are faring in a metric world. The second day will consider how the Federal Government could be reorganized to provide more appropriate assistance to industries which are having trouble competing in world markets. We want to look particularly at the semiconductor industry in that instance as a focus for discussion. And, then the final day we'll look at some of the President's suggestions on competitiveness, on technology transfer legislation and on a number of other issues that remain in Federal patent policy.

We want to start with the National Bureau of Standards because it's hard to think of an agency which could have a more direct impact on competitiveness and on the quality of manufactured products. And, when we look back on this period in history, it will certainly strike people that at the time that America was in a broad decline in terms of its competitive posture in world markets, in that same time frame the budget of the National Bureau of Standards had steadily declined. We will give special focus to two proposals to change, the focus of the present National Bureau of Standards. Congressman Ritter has a bill that would create a National Bureau of Standards and Industrial Competitiveness, and Senator Hollings has legislation that would focus the National Bureau of Standards as a National Institute of Technology. I think it's clear that somehow or another what we do at the Bureau of Standards has to capture the imagination and the appreciation of the American public. At present that has not happened.

Our discussion of the metric system will center on Congressman Brown's bill, which would require the metric system of measurement to be used for Federal programs and procurement in the absence of a good reason to the contrary. Well, we'll be able to talk about these things through the hearings and I want to at this point, recognize the ranking minority member for any opening comments he may want to make and then we will recognize others and proceed.

Mr. Boehlert?

Mr. **Boehlert**. Thank you, Mr. Chairman.

The hearings we begin today really focus on two essential questions: How can we ensure that the government sponsors research that industry can use, and how can we ensure that industry does use that research.

The bills before us this week, including mine, answer those questions with new Government organizations and new Government programs. I think that throughout these hearings we should regard such answers with a healthy skepticism. The Government can and should do more, but much of what needs to be done now, can and should be done by industry.

A look at our chief competitor is instructive. Japan, as we all know, has grown wealthy by adopting the results of American research. The Japanese have now taken the logical next step and are, in effect, turning our universities into "surrogate mothers." Japanese firms provide the "seed money" for research, and then after the gestation period when the research is usable, our researchers turn it back to the Japanese to develop and take around the world. The Japanese, apparently, think our research is neither insufficiently targeted nor inaccessible.

Why don't American firms make equal use of our research? It's hard to know. Do we need additional programs to coax universities and industry to get together? Perhaps we do. But, before we replace Adam Smith's invisible hand with Uncle Sam's outstretched one, we'd best be sure increased competitiveness will be the result.

We've already taken some important steps toward increasing competitiveness through cooperation. The National Science Foundation's engineering research centers and the Technology Transfer Act, both championed by this subcommittee, are prime examples.

The States, which are the Government's political science laboratories, have also created innovative programs to promote technology transfer. Both Congresswoman Schneider and I plan to introduce bills that would build on those programs.

So, the question is not whether Government has a role, but whether that role needs to be expanded. Should the Government, for example, be in the business of financing commercialization of products or processes? Will firms, particularly small ones, be uninterested in using new technology if the Government doesn't hand it to them on a silver platter? I'm not sure if Senator Hollings and I would answer these questions the same way.

Similarly, given the current governmentwide concern, even obsession, with competitiveness, I'm not sure how much reorganization would accomplish. As public officials, we don't like to believe there are problems beyond our control, but it may be that corporate rather than Government restructuring is the more urgent need. Before we create too many new programs, we ought to be sure our existing research and education programs are funded adequately. They aren't.

When Assistant Secretary Perle testified here last week, he derided "competitiveness" as a "slogan masquerading as a policy." We ought to approach our assignment this week with some humility and some skepticism, lest we do something that proves Mr. Perle correct.

Thank you, Mr. Chairman.

Mr. **Walgren**. Thank you, Mr. Boehlert.

Are there other opening thoughts that members would like to share?

[No response.]

Mr. **Walgren**. If not, let's call first our colleague, Congressman Ritter from Pennsylvania, who has been interested in this committee's jurisdiction for the past number of years and has particularly focused on trying to make the best suggestions he can for the Bureau of Standards and for the question of what the government can contribute to competitiveness through our Federal science establishment.

Mr. Ritter, we're certainly happy to have you with us, both there on that side of the table, and here on this side of the table.

Your prepared statement will be inserted in the record, so, why don't you proceed and we look forward to your testimony.

STATEMENT OF HON. DON RITTER, A U.S. REPRESENTATIVE FROM PENNSYLVANIA, AND A MEMBER OF THE SCIENCE, SPACE, AND TECHNOLOGY COMMITTEE

Mr. **Ritter**. Thank you very much, Mr. Chairman. And, I commend you for holding these hearings on this most important subject. I look forward to, not only testifying, but to attending and playing an active role in the hearings.

I'm pleased to testify today before our Subcommittee on Science, Research and Technology regarding legislation I recently introduced, that was originally cosponsored by you, Mr. Chairman, Congressman Boehlert, Congressman Brown from California, Congressman Glickman from Kansas, and Congressman Morrison from Washington, and other members of the Science and Technology Committee, entitled the "National Bureau of Standards and Industrial Competitiveness Act of 1987."

I believe that manufacturing is still the foundation of our Nation's economy and will continue to be critical to future economic success and stability. If this Nation cannot significantly improve its ability to develop and manufacture innovative and quality products, we cannot but witness a decline in the American standard of living.

In the past, America's greatest strength was derived from our ability to take research results and produce innovative technological products for the world. Over the last few years, however, the rest of the industrial world has learned how to capitalize on our government's and private sector's R&D investment for new product development, in many cases faster and better than us.

America's ability to compete on an unlevel playing field has been the banner waived on international trade issues, but in too many industries we're just not winning the race to commercialize our own scientific innovations. The United States requires 3 to 5 years to commercialize developments that take 2 to 3 years in Europe and 1 to 2 years in Japan. VCR's were invented here, but developed to commercial dominance in Japan, as were just about all the major innovations in consumer electronics. We've seen what's happened to large scale semiconductor production. Will biotechnology and superconductivity be next? The race, my colleagues, is already on to develop superconducting materials and products. The Japanese Ministry of International Trade and Industry [MITI], coalition with industry and academe and the national laboratories met 8 days after the University of Houston researchers announced their breakthrough on superconductivity, and they began formulating strategies for applying this science to new products to beat the rest of the world.

To address this problem of American manufacturing industry's ability to compete worldwide, I've introduced H.R. 2068. The bill is designed to focus the Federal Government's efforts on the issue of industrial competitiveness in a cost effective way by better utilizing and expanding the horizons of this Nation's preeminent industrial national laboratory, the National Bureau of Standards.

Of all the Government laboratories, NBS has the most experience in pooling industry resources to solve problems and meet new technological challenges. NBS has been a flagship laboratory for America and leads in such important fields as manufacturing automation, robotics, and materials development.

The bill would establish an Industrial Competitiveness Division within the Department of Commerce's National Bureau of Standards and redesignate the National Bureau of Standards as the National Bureau of Standards and Industrial Competitiveness [NBSIC].

Let me just run through a few of the activities of this new division. First of all, it would act as the Government's focal point for industrial competitiveness programs. We have seen orphan children industrial competitiveness activities in a dozen different Federal agencies. There is no Federal focus on R&D in these areas today.

It would evaluate, on a continuing basis, the long-term impact of Government-sponsored research and development investments on industrial competitiveness. We don't do that. We make these massive investments, but we don't consider, we don't evaluate what their impact has been on America's position in the global economy.

With the assistance of other agencies, the NBSIC would promote the most promising research and development which can be optimized for industrial applications.

It would encourage and participate in cooperative programs, with industry, universities, and other Government laboratories, which are designed to transfer advanced technology to small business and industry engaged in production and manufacturing.

It would stimulate the development of proprietary products and processes that will expand industrial competitiveness in the United States.

It would provide seed funds to further the formation of cooperative programs.

It would support and encourage the adoption of advanced and flexible manufacturing concepts by American Industry.

It would create a clearinghouse of best practice information and techniques for continuous improvement of industrial quality and productivity. It would include those successful quality improvement strategies and programs that have received special government or industry recognition.

Mr. Chairman, our committee has a bill to create a Deming prize in order to focus on quality improvement and continuous improvement on these innovations in management, and we could use a federal focus, an agency that had this as its own responsibility in addition to having the award and the honor.

It would identify regulatory and other barriers to increased productivity, product commercialization and competitiveness.

And, it would initiate work on the concept of competitiveness impact statements, which could serve as an additional tool to study the potential impact major actions of federal agencies have on international trade and the ability of the U.S. firms to compete in domestic and foreign markets.

We already have introduced, and in fact Chairman Florio and myself, of the Energy and Commerce Committee, have introduced an amendment to the trade bill this year on competitiveness impact statements. But, I could assure you that we know very little about what a competitiveness impact statement means, and it would be, I think, useful to have the theory and the concept studied and analyzed by some function in the Federal Government.

To ensure a responsive and effective program, the industrial competitiveness effort at NBS would be guided by an Industrial Competitiveness Board. The advisory board would be composed of three Government representatives and seven members from the private sector representing a cross section of America's industrial base, including small business. The idea here is that the board is really a representative group of private sector institutions and organizations, and that they are the dominate force in such a board. The board would review and approve programs, budgets, and operations of the Bureau's Industrial Competitiveness Division. It would be similar to the authority and functions of the National Science Board and how it relates to the National Science Foundation.

It is expected the effort will be successful and will contribute to improved U.S. industrial competitiveness, and proceeds derived from royalties and other income generated by NBSIC will be placed in a trust fund to make the industrial competitiveness operation as self supporting as possible. Legislation that this committee has been active in, that has allowed the national laboratories the ability to achieve royalties and other income from their innovations and apply to this industrial competitiveness activity as well. To provide a strong foundation for this program, funds are authorized at $20 million for the first year, $30 million for the next 2 fiscal years, and $50 million for the following 5 years.

In the past, R&D sponsored by the Department of Defense, Mr. Chairman and my colleagues, has often served as a catalyst for advances in private sector manufacturing such as those witnessed in semiconductors, and computers, and aerospace. But, as MIT's Charles Ferguson notes, "commercial markets for semiconductors outpaced military demand, which became financially less important and lagged behind commercial technology". With the explosion of the global economy, the explosion of global innovation, we are seeing a lag of military technology behind civilian technology.

Given the pace of technological advances, this scenario has probably been repeated in many industries in addition to semiconductors. Yet, because of funding inadequacies, we are still willing to let DOD take the initiative concerning many commercial technologies. This is apparent with the Defense Science Board's recent recommendations to establish a semiconductor manufacturing institute, SEMATECH. This member introduced the SEMATECH amendment in the Energy and Commerce part of the trade bill to bring that function into the Commerce Department. But, it seems that often DOD is the only organization that has the money. By not having a focal point for nondefense industrial technology, we will continue to see this void filled by DOD, because they do have the funding. They do have a legitimate interest in a strong manufacturing base. However, DOD's mission needs are clearly different from those of a commercial marketplace.

Further, high technology has become interdisciplinary, with scientific advances applying to product development in many fields and industries. This is another reason to provide a focal point for coordinating and promoting new technological developments with potential industrial applications. For example, the Department of Energy has primary authority over superconducting materials research, but we all know that these new breakthroughs in superconductivity apply across the board, well beyond just energy. Does DOD have the ability to help industries formulate strategies for applying recent breakthroughs in superconductivity to new products?

While our Federal R&D organization has worked effectively in the past, it's evident that it's not sufficiently responsive to the private sector's needs in today's new global competitive economy. With the advent of a new global economy it's necessary for us to fine tune and adjust the Federal Government's role in advising and assisting private industry, helping to fund new innovation, and to help it endure this economic transition.

I believe my approach to better utilize the existing, and successful, entity of NBS in addressing our Nation's manufacturing problems is a modest, cost effective and responsive approach. NBS has a good track record, but budget cuts and a lack of Federal recognition, public recognition of the importance of manufacturing to the American economy has resulted in our virtually ignoring perhaps the best Federal resource which could contribute to improved industrial competitiveness. Some of the other bills introduced—we'll be addressing those bills as well in these hearings, to focus on the problems facing American industry create new and large bureaucracies which could conceivably require years to organize and to respond effectively to America's needs.

Mr. Chairman and my colleagues, I believe my legislation could provide an immediate and an appropriate response to the new global challenge.

Thank you.

[The prepared statement of Mr. Ritter follows:]

HON. DON RITTER (R-PA)

TESTIMONY BEFORE THE SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
ON H.R. 2068
THE NATIONAL BUREAU OF STANDARDS AND INDUSTRIAL COMPETITIVENESS

APRIL 28, 1987

Introduction

Thank you, Mr. Chairman. I am pleased to testify today before the Subcommittee on Science, Research and Technology regarding legislation recently introduced by myself as well as you (Congressman Walgren), and Congressmen Boehlert, Brown (CA), Glickman, and Morrison (WA) entitled the National Bureau of Standards and Industrial Competitiveness.

I believe that manufacturing is still the foundation of our nation's economy and will continue to be critical to future economic success and stability. If this nation cannot significantly improve its ability to develop and manufacture innovative and quality products, we cannot but witness a decline in the American standard of living.

In the past, America's greatest strength was derived from our ability to take research results and produce innovative technological products for the world. Over the last few years, however, the rest of the industrial world has learned how to capitalize on our government's and private sector's R&D investment for new product development -- in many cases faster and better than us.

America's ability to compete on an unlevel playing field has been the banner waved on international trade issues, but in too many industries we are just not winning the race to commercialize our own scientific innovations. The U.S. requires 3 to 5 years to commercialize developments that only take 2 to 3 years in Europe, and 1 to 2 years in Japan. VCR's were invented here, but developed to commercial dominance in Japan, as were just about all the major innovations in consumer electronics. We've seen what has happened to large scale semiconductors. Will biotechnology and superconductivity be next? The race is already on to develop superconducting materials and products. The Japanese MITI (Ministry of International Trade and Industry) coalition met 8 days after IBM announced its breakthrough on superconductivity, and began formulating strategies for applying this science to new products.

H.R. 2068

To address this problem of American manufacturing industry's ability to compete worldwide, I have introduced H.R. 2068. The bill is designed to focus the federal government's efforts on the issue of industrial competitiveness in a cost effective way by better utilizing and expanding the horizons of this nation's preeminent industrial national laboratory, the National Bureau of Standards (NBS).

Of all the government laboratories, NBS has the most experience in pooling industry resources to solve problems and meet new technological challenges. NBS has been a flagship laboratory for America and leads in such important fields as manufacturing automation, robotics, and materials development.

The bill would establish an Industrial Competitiveness Division within the Department of Commerce's National Bureau of Standards and redesignate the Bureau as the National Bureau of Standards and Industrial Competitiveness (NBSIC).

Through this new Division, NBS would:

- act as the Government's focal point for industrial competitiveness programs;

- evaluate, on a continuing basis, the long-term impact of Government-sponsored research and development investments on industrial competitiveness;

- with the assistance of other agencies, promote the most promising research and development which can be optimized for industrial applications;

- encourage and participate in cooperative programs, with industry, universities and other Government laboratories, which are designed to transfer advanced technology to small business and industry engaged in production and manufacturing;

- stimulate the development of proprietary products and processes that will expand industrial competitiveness in the U.S.;

- provide seed funds to further the formation of cooperative programs;

- support and encourage the adoption of advanced and flexible manufacturing concepts by American industry;

- create a national clearinghouse of "best practice" information and techniques for continuous improvement of industrial quality and productivity, including those successful quality improvement strategies and programs that have received special government or industry recognition;

- Identify regulatory and other barriers to increased productivity, product commercialization and competitiveness; and

- Initiate the concept of Competitiveness Impact Statements, which could serve as an additional tool to study the potential impact major actions of federal agencies have on international trade and the ability of U.S. firms to compete in domestic and foreign markets.

To ensure a responsive and effective program, the Industrial Competitiveness effort at NBS would be guided by an Industrial Competitiveness Board. The advisory board would be composed of 3 government representatives and 7 members from the private sector representing a cross-section of America's industrial base, including small business. The Board would review and approve programs, budgets, and operations of the Bureau's Industrial Competitiveness Division, similar to the authority and functions of the National Science Board in relation to the National Science Foundation.

It is expected that this effort will be successful and will contribute to improved U.S. industrial competitiveness. The proceeds derived from royalties and other income generated by NBSIC will be placed in a trust fund to make the Industrial Competitiveness operation as self-supporting as possible. To provide a strong foundation for this program, funds are authorized at $20 million for the first year of operation, $30 million for the next two fiscal years, and $50 million for the following five years, for a total of $330 million for eight years.

Legislative Comparison

In the past, research and development sponsored by the Department of Defense has often served as a catalyst for advances in private sector manufacturing such as those witnessed in semiconductors, and computers, and aerospace. But, as MIT's Charles Ferguson notes, "commercial markets for semiconductors outpaced military demand, which became financially less important and lagged behind commercial technology".

Given the pace of technological advances, this scenario has probably been repeated in many other industries. Yet becuase of funding inadequacies, we are still willing to let DOD take the initiative concerning many commercial technologies. This is apparent with the Defense Science Board's recommendations to establish a semiconductor manufacturing institute. By not having a focal point for non-defense industrial technology, we will continue to see this void filled by DOD, which does have a legitimate interest in a strong manufacturing base. However, DOD's needs are clearly different than those of the commercial marketplace.

Further, high technology has become interdisciplinary, with scientific advances applying to product development in many fields and industries. This is another reason to provide a focal point for coordinating and promoting new technological developments with potential industrial applications. For example, the Department of Energy has primary authority over superconducting materials research. Does DOE have the ability to help industries formulate strategies for applying recent breakthroughs in superconductivity to new products?

While our federal research and development organization has worked effectively in the past, it is evident that it is not sufficiently responsive to the private sector's needs. With the advent of a new global economy, it is necessary for us to fine-tune and adjust the federal government's role in advising and assisting private industry to help it endure this economic transition.

I believe my approach to better utilize the existing, and successful, entity of the NBS in addressing our nation's manufacturing problems is a modest, cost effective and responsive approach. NBS has a good track record, but budget cuts and a lack of federal recognition of the importance of manufacturing to the American economy has resulted in our virtually ignoring perhaps the best federal resource which could contribute to improved industrial competitiveness. Some of the other bills introduced to address the problems facing American industry create new and large bureaucracies which could conceivably require years to organize and respond effectively to America's needs. I believe my legislation could provide an appropriate and a rapid response to the new global challenge.

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100TH CONGRESS
1ST SESSION

H. R. 2068

To establish the National Bureau of Standards and Industrial Competitiveness, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

APRIL 9, 1987

Mr. RITTER (for himself, Mr. WALGREN, Mr. BOEHLERT, Mr. BROWN of California, Mr. GLICKMAN, and Mr. MORRISON of Washington) introduced the following bill; which was referred jointly to the Committees on Science, Space, and Technology and Energy and Commerce

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A BILL

To establish the National Bureau of Standards and Industrial Competitiveness, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "National Bureau of Standards and Industrial Competitiveness Act of 1987".

SEC. 2. FINDINGS.

The Congress finds and declares the following:

(1) America's manufacturing industries are confronting strong competition in both domestic and world

markets. Leading offshore industrial countries as well as emerging and developing nations are increasingly taking advantage of inexpensive labor, modern technology, and favorable government support to produce manufactured products which compete very favorably with those of American industry.

(2) While the United States is changing the face of its industrial economy, the key to maintaining and ensuring the future health and wealth of the American economy is in a strong manufacturing base.

(3) Since its establishment, the National Bureau of Standards has had responsibility for assisting in the improvement of industrial technology. It has taken a lead role in stimulating cooperative work among private industrial organizations in efforts to surmount technological hurdles. The National Bureau of Standards has served as the national and industry focal point in developing automated manufacturing technologies, improved process sensors for the steel and aluminum industries, more precise construction techniques, textile flammability advances, and the basic measurement standards for the semiconductor industry. The National Bureau of Standards has already begun research and development initiatives in various new technologies, in-

cluding biotechnology and bioprocessing, advanced ceramics and polymers, and advanced electronics.

SEC. 3. PURPOSE.

It is the purpose of this Act, through the National Bureau of Standards and Industrial Competitiveness—

(1) to promote private sector initiatives to capitalize on advanced technology;

(2) to identify, with the cooperation of all Federal agencies, Government-sponsored research and development efforts which offer the potential of industrial applications to strengthen America's competitiveness,

(3) to select and develop through cooperative efforts between industries, universities, and government laboratories, the most promising research and development products, which can be optimized for commercial and industrial applications; and

(4) to promote shared risks, accelerated development and commercialization time and pooling of skills which will be necessary to strengthen America's manufacturing industries.

SEC. 4. DEFINITIONS.

As used in this Act—

(1) the term "Bureau" means the National Bureau of Standards and Industrial Competitiveness as designated by section 5(a);

(2) the term "Secretary" means the Secretary of Commerce;

(3) the term "Director" means the Director of the National Bureau of Standards and Industrial Competitiveness;

(4) the term "Deputy Director" means the Deputy Director for Industrial Competitiveness appointed pursuant to section 5(b);

(5) the term "Division" means the Industrial Competitiveness Division established by such section;

(6) the term "Board" means the Industrial Competitiveness Board established by section 7(a); and

(7) the term "Fund" means the Industrial Competitiveness Fund established by section 11.

SEC. 5. NATIONAL BUREAU OF STANDARDS AND INDUSTRIAL COMPETITIVENESS.

(a) Redesignation.—The National Bureau of Standards of the Department of Commerce shall, after the date of enactment of this Act, be known as the National Bureau of Standards and Industrial Competitiveness. Reference in any other Federal law to the National Bureau of Standards shall be deemed to refer to the National Bureau of Standards and Industrial Competitiveness.

(b) Industrial Competitiveness Division.—There shall be within the Bureau an Industrial Competitiveness Division. The Division shall, subject to the requirements of section 7 (relating to the Industrial Competitiveness Board), be headed by a Deputy Director for Industrial Competitiveness who shall be appointed by the President, by and with the advice and consent of the Senate. Before any person is appointed as Deputy Director, the President shall afford the Board an opportunity to make recommendations with respect to such appointment.

(c) COMPENSATION OF DIRECTOR AND DEPUTY DIRECTOR.—Subchapter II of chapter 53 of title 5, United States Code, is amended—

(1) by adding at the end of section 5314 the following:

"Director, National Bureau of Standards and Industrial Competitiveness, Department of Commerce.";

(2) by adding at the end of section 5315 the following:

"Deputy Director for Industrial Competitiveness, National Bureau of Standards and Industrial Competitiveness, Department of Commerce."; and

(3) by striking out "Director, National Bureau of Standards, Department of Commerce." in section 5316.

SEC. 6. INDUSTRIAL COMPETITIVENESS FUNCTIONS OF THE BUREAU.

The Director of the Bureau is authorized and directed, through the Division—

(1) to act as the Government's focal point for industrial competitiveness programs;

(2) to evaluate, on a continuing basis, the long-term impact of Government-sponsored research and development investments on industrial competitiveness;

(3) with the assistance and support of the Board and appropriate government agencies, to promote the most promising research and development which can be optimized for industrial applications;

(4) to encourage and participate in cooperative programs which employ the management, technical and financial resources of industry, universities, and Government laboratories and which are designed to transfer advanced technology to small business and industry engaged in production and manufacturing and to stimulate the development of proprietary products and processes that will expand the industrial competitiveness in the United States;

(5) to assist further the formation of cooperative programs by providing seed funds to interested persons;

(6) to support and encourage adoption of advanced and flexible manufacturing concepts by American industry;

(7) to provide United States business and government with a national clearinghouse of "best practice" information and techniques for continuous improvement of quality and productivity, including those successful quality improvement strategies and programs that have received special government or industry recognition;

(8) to identify regulatory and other barriers to increased productivity, product commercialization and competitiveness;

(9) to initiate and coordinate, with the assistance and support of the Board and appropriate government agencies, the drafting of Competitiveness Impact Statements prior to any major legislative or administrative action being taken that may affect international trade and industrial competitiveness of United States industry.

As part of the Competitiveness Impact Statement under paragraph (9), the Bureau shall, before taking any major action that may affect international trade and competitiveness—

(A) study the potential impact such action will have on—

(i) the international trade of the United States, and

(ii) the ability of United States firms engaged in the manufacture, sale, distribution or providing of goods or services to compete in foreign or domestic markets,

(B) prepare a detailed statement on such study, and

(C) make such statement available to the public.

In the case of emergency action, the statement required under subparagraph (B) may be published immediately after the actions affecting international competitiveness is taken.

SEC. 7. INDUSTRIAL COMPETITIVENESS BOARD.

(a) Appointment.—There shall be within the Bureau an Industrial Competitiveness Board. The Board shall exercise general supervision and policy control of the Division. The Board shall consist of eight members, appointed by the Secretary, after consultation with appropriate private sector research and development and technology-based organizations (such as industrial companies, and trade and product associations).

(b) Membership.—Of the persons appointed to the Board—

(1) three shall be from the Federal Government; and

(2) seven shall be from the private sector representing a cross-section of American's industrial base, including large and small business.

(c) CHAIRPERSON AND VICE-CHAIRPERSON.—The Secretary shall designate one member of the Board as chairperson and one member as vice-chairperson for a term of office not to exceed three years. The vice-chairperson shall perform the duties of the chairperson in the latter's absence. In case a vacancy occurs in the chairpersonship or vice-chairpersonship, the Board shall elect a member to fill such vacancy.

(d) TERMS.—The term of Office of each member of the Board shall be three years, except that—

(1) any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed for the remainder of such term; and

(2) the terms of office of the three members first taking office under subsection (b)(2) shall expire, as designated at the time of their appointment, one at the end of one year, one at the end of two years, and one at the end of three years.

No member shall be eligible to serve in excess of two consecutive terms. The initial Board members shall be appointed not later than ninety days after the date of the enactment of this Act.

(e) MEETINGS.—The Board shall meet at least once every three months at the call of the chairperson, or upon the written request of two of the members. A majority of the voting members of the Board shall constitute a quorum.

(f) COMPENSATION.—Members of the Board appointed from the private sector under subsection (b)(2) may receive compensation when engaged in the business of the Bureau at a rate fixed by the chairperson but not exceeding the daily equivalent of the rate provided for level GS-18 of the General Schedule under section 5703 of title 5, United States Code, and shall be allowed travel expenses as authorized by section 5703 of title 5, United States Code. Members who receive such payment shall not be considered employees of the United States.

(g) ADDITIONAL AUTHORITY.—The Board shall—

(1) establish the policies of the Bureau relating to functions under this Act, in accordance with applicable policies established by the President and the Congress;

(2) assist in the drafting of the budget of the Division; and

(3) approve or disapprove every grant, contract, or other funding arrangement proposed under the Division, except that a grant, contract, or other funding ar-

rangement involving a commitment of less than $200,000 may be made by the Deputy Director without specific Board action, if the Board previously reviewed and approved the program of which that commitment is a part.

(h) COMMISSIONS.—The Board is authorized to establish such special commissions as it may from time to time deem necessary for the purposes of this Act.

(i) CONSULTATION IN BUDGETARY DECISIONS.—The Secretary shall provide assistance to the Board in carrying out its functions as described under subsection (g).

(j) PLANNING OF DIVISION PROGRAMS.—As a basis for the selection and conduct of the Division's programs, the Deputy Director shall prepare, for the approval of the Board, a short-range plan of activities and a long-range plan of activities. Each plan shall as fully as possible prioritize the full range of research activities appropriate to the Bureau. Such plans shall be prepared within one year after the initial selection of the Deputy Director, and each such plan shall be updated annually.

SEC. 9. ANNUAL REPORTING.

The Deputy Director shall submit an annual report to the Director, the Secretary, and to Congress, detailing activities of the Division, including staff changes, status, and operational costs, together with an accounting of program allocations and project activity including current status of each project in the Division.

SEC. 10. STANDARDS AND INDUSTRIAL COMPETITIVENESS FUND.

(a) ESTABLISHMENT AND PURPOSE.—There is established in the Treasury of the United States the Standards and Industrial Competitiveness Fund. The fund shall be available to the Director, in accordance with appropriations Acts but without fiscal year limitation, for use as a revolving fund to carry out the industrial competitiveness activities of the Bureau.

(b) DEPOSITS TO THE FUND.—There shall be deposited in the Fund—

(1) funds appropriated pursuant to section 11 of this Act;

(2) payments received from any source for products, services, or property furnished in connection with Bureau activities;

(3) royalties earned by the Bureau from successfully commercialized products funded in whole or part by grants or cooperative agreements executed by the Bureau; and

(4) donations accepted by the Director on behalf of the Bureau, as provided for in section 9(a)(7).

SEC. 11. AUTHORIZATION OF APPROPRIATIONS.

There is authorized to be appropriated to the Fund $20,000,000 for the fiscal year beginning after enactment of this Act, $30,000,000 for the next two fiscal years, and $50,000,000 for the next five fiscal years.

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II

100TH CONGRESS
1ST SESSION

S. 907

To further United States technological leadership by providing for support by the Department of Commerce of cooperative centers for the transfer of research in manufacturing, and for other purposes.

IN THE SENATE OF THE UNITED STATES

APRIL 3 (legislative day, MARCH 30), 1987

Mr. HOLLINGS (for himself and Mr. RIEGLE) introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

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A BILL

To further United States technological leadership by providing for support by the Department of Commerce of cooperative centers for the transfer of research in manufacturing, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Technology Competitiveness Act of 1987".

TITLE I—NATIONAL INSTITUTE OF TECHNOLOGY

SEC. 101. Section 1 of the Act of March 3, 1901 (15 U.S.C. 271), is amended to read as follows:

"FINDINGS AND PURPOSES

"SECTION 1. (a) The Congress finds and declares that—

"(1) United States economic growth and industrial competitiveness require continual improvements in manufacturing technology, quality control, and techniques for ensuring product reliability and cost-effectiveness;

"(2) improvements in manufacturing and product technology depend on fundamental scientific and engineering research, in cooperation with industry, to develop (A) the precise and accurate measurement methods and measurement standards needed to improve quality and reliability, and (B) new technological processes by which such improved methods may be used in practice to improve manufacturing and to assist industry to transfer important laboratory discoveries into commercial products;

"(3) interstate commerce, scientific progress, public safety, and product compatibility and standardization also depend on the development of precise measurement methods, standards, and related basic technologies;

"(4) because no one manufacturer or group of manufacturers is able to provide these essential technical services, the Federal Government should maintain a national science and technology laboratory which is able to provide methods, measurement standards, and associated technologies and which is able to work with United States companies to use new techniques to improve products and manufacturing processes; and

"(5) the Federal Government's measurement and technology laboratory also can and should serve as a clearinghouse to assist trade associations, State technology programs, labor organizations, and universities to disseminate information on new basic technologies, including automated manufacturing processes, to interested large and small industrial companies which face strong competition from foreign sources.

"(b) It is the purpose of this Act to establish a National Institute of Technology to serve as a national laboratory which will provide the measurement and technological services essential for scientific and engineering progress, interstate commerce, improved product reliability and manufacturing processes, and guaranteeing that products protect public safety.".

SEC. 102. Section 2 of the Act of March 3, 1901 (15 U.S.C. 272), is amended to read as follows:

"ESTABLISHMENT, FUNCTIONS, AND ACTIVITIES

"SEC. 2. (a) There is established within the Department of Commerce a science and technology laboratory to be known as the National Institute of Technology (hereinafter referred to as the 'Institute'.).

"(b) The Secretary of Commerce (hereinafter referred to as the 'Secretary') is authorized to—

"(1) develop, maintain, and retain custody of the national standards of measurement, and provide the means and methods for making measurements consistent with those standards, including comparing standards used in scientific investigations, engineering, industry, commerce, and educational institutions with the standards adopted or recognized by the Federal Government;

"(2) contribute to United States industrial capacity by conducting research and cooperating with industry to develop the measurements, measurement methods, and basic technology needed to improve quality control, to modernize manufacturing processes, to ensure product reliability, manufacturability, functionality, and cost-effectiveness, and to facilitate the more rapid commercialization of products based on new scientific discoveries in fields such as automation, advanced materials, biotechnology, and optical technologies;

"(3) determine, compile, and evaluate physical constants and the properties and performance of conventional and advanced materials when they are important to science, engineering, education, commerce, and industry and are not available with sufficient accuracy elsewhere;

"(4) develop a fundamental basis and methods for testing materials, mechanisms, structures, equipment, and systems, including those purchased for the use of the Federal Government;

"(5) assure the compatibility of United States national standards with those of other nations;

"(6) cooperate with other departments and agencies of the Federal Government, industry, and private organizations in establishing standard practices, incorporated in codes, specifications, and voluntary consensus standards;

"(7) advise government and industry on scientific and technical problems;

"(8) invent, develop, and (when appropriate) promote transfer to the private sector of devices to serve special national needs; and

"(9) assist interested trade associations, State technology agencies, labor organizations, and universities to disseminate information on new basic product and process technologies, particularly automated manufacturing technologies, to interested medium-sized and small companies throughout the United States.

"(c) In carrying out the functions specified in subsection (b) of this section, the Secretary may—

"(1) construct physical standards;

"(2) test, calibrate, and certify standards and standard measuring apparatus;

"(3) study and improve instruments, measurement methods, and industrial quality control and quality assurance techniques;

"(4) cooperate with the States in securing uniformity in weights and measures laws and methods of inspection;

"(5) prepare, certify, and sell standard reference materials for use in ensuring the accuracy of chemical analyses and measurements of physical and other properties of materials;

"(6) accept research associates and donated equipment from industry and also engage with industry in research to develop new basic and generic technologies for traditional and new products and for improved production and manufacturing;

"(7) study and develop fundamental scientific understanding and improved measurement methods for chemical substances and compounds, traditional and advanced materials, ionizing and nonionizing radiation, radio waves and signals, and electromagnetic signals;

"(8) develop and test standard interfaces, communication protocols, and data structures for computer, automation, and telecommunications systems;

"(9) perform research to develop standards and test methods to advance the effective use of computers and related systems and to protect the information stored, processed, and transmitted by such systems;

"(10) determine properties of building materials and structural elements, and encourage their standardization and most effective use, including investigation of fire-resisting properties of building materials and conditions under which they may be most efficiently used, and the standardization of types of appliances for fire prevention;

"(11) undertake such research in engineering, mathematics, computer science, materials science, and the physical sciences as may be necessary to carry out and support the functions specified in this section;

"(12) compile, evaluate, publish and otherwise disseminate general scientific and technical data resulting from the performance of the functions specified in this section or from other sources when such data are important to science, engineering, or industry, or to the general public, and are not available elsewhere;

"(13) demonstrate the results of the Institute's activities by exhibits or otherwise as may be deemed most effective, and including the use of scientific or technical personnel of the Institute for part-time or intermittent teaching and training activities at educational institutions of higher learning as part of and incidental to their official duties; and

"(14) undertake such other functions similar to those specified in this subsection as the Secretary determines appropriate.".

Sec. 103. The first section of the Act of July 16, 1914 (15 U.S.C. 280), the first section of the Act of March 4, 1913 (15 U.S.C. 281), and the first section of the Act of May 14, 1930 (15 U.S.C. 282), are repealed.

Sec. 104. The Act of March 3, 1901 (15 U.S.C. 271 et seq.), is amended by adding at the end the following:

"STUDIES BY THE NATIONAL ACADEMIES OF ENGINEERING AND SCIENCES

"Sec. 19. The Director shall, to the extent appropriations are available, periodically contract with the National Academy of Engineering and the National Academy of Sciences for advice and studies to assist the Institute to serve United States industry and science. The advice and studies may include—

"(1) significant national needs and opportunities in manufacturing and emerging technologies; and

"(2) potential activities of the Institute, in cooperation with industry and the States, to assist in the transfer and dissemination of new technologies for manufacturing and quality assurance.".

SEC. 105. The Act of March 3, 1901 (15 U.S.C. 271 et seq.), is amended by striking "National Bureau of Standards", "Bureau" and "bureau" wherever they appear and inserting in lieu thereof "Institute".

TITLE II—COOPERATIVE CENTERS FOR THE TRANSFER OF RESEARCH IN MANUFACTURING

SEC. 201. The Act of March 3, 1901 (15 U.S.C. 271 et seq.), as amended by this Act, is further amended by adding at the end the following:

"SEC. 20. (a) The Secretary, through the Director, shall provide assistance for the creation and support of regional Cooperative Centers for the Transfer of Research in Manufacturing. Such Centers shall be affiliated with any university, or other nonprofit institution, or group thereof, that applies for and is awarded a grant or enters into a cooperative agreement under this section. Individual awards shall be decided on the basis of merit review, peer review, or similar mechanism. The objective of the Centers is to enhance productivity and technological performance in United States manufacturing through—

"(1) the transfer of new basic manufacturing technology and techniques developed at the Institute to Centers and, through them, to manufacturing companies throughout the United States;

"(2) the participation of individuals from industry, universities, State governments, and, when appropriate, the Institute in cooperative research and technology transfer and research activities;

"(3) the training, education and participation of individuals in the use of new manufacturing and production technologies;

"(4) the further development of a generic research base in manufacturing technology, with special attention to economically significant activities in which individual companies have little incentive to perform themselves, to state-of-the-art manufacturing issues, and to efforts to make new manufacturing technology and processes usable by small and medium-sized companies in the United States;

"(5) the dissemination of scientific, engineering, and technical information about manufacturing to other researchers and to industrial firms, including small and medium-sized manufacturing companies;

"(6) the utilization, when appropriate, of the expertise and capability that exists in Federal laboratories other than the Institute; and

"(7) the development of continuing financial support from other mission agencies, from State and local governments, and from industry and universities through, among other means, fees, licenses, and royalties.

"(b) The activities of the Centers shall include—

"(1) the establishment of experimental automated manufacturing systems, based on research by the Institute, for the purpose of demonstrations, technology transfer, and research;

"(2) the transfer and dissemination of research findings and Center expertise to a wide range of companies and enterprises, including, whenever possible, small and medium-sized manufacturers; and

"(3) basic research supportive of technological and industrial innovation in manufacturing processes, including the adaptation of robotics, computer-integrated manufacturing, and systems integration to meet the generic needs of specific types of manufacturing industries.

"(c)(1) The Secretary may provide financial support to any Center created under subsection (a) of this section for a period not to exceed ten years. The Secretary may not provide to a Center more than 50 per centum of the capital and annual operating and maintenance funds required to create and maintain such Center.

"(2) A person may submit to the Secretary an application for financial support under this subsection. In order to receive assistance under this section, an applicant shall provide information considered adequate by the Secretary that private, university, State, or other non-Federal sources have furnished adequate assurances of contributions of funds equal to or greater than 50 per centum of the proposed Center's capital and annual operating and maintenance costs. Each applicant shall also submit, as part of such applicant's proposal, a plan for the allocation of the legal rights associated with any invention which may result from the proposed Center's research and technology transfer activities.

"(3) The Secretary shall subject each such application to merit review, peer review, or other similar process. In making a decision whether to approve such application and provide financial support under this subsection, the Secretary shall consider (A) the merits of the application, particularly those portions of the application regarding technology transfer, training and education, and research to adapt manufacturing technologies to the needs of particular industrial sectors, and (B) geographical diversity.

"(4) The provisions of chapter 18 of title 35, United States Code, shall (to the extent not inconsistent with this section) apply to the promotion of technology from research by Centers under this section.

"(d) There are authorized to be appropriated for the purposes of carrying out this section not to exceed $40,000,000 for fiscal year 1988, not to exceed $40,000,000 for fiscal year 1989, and not to exceed $40,000,000 for fiscal year 1990.".

TITLE III—PRODUCTIVITY AND TECHNOLOGY ADMINISTRATION

SEC. 301. (a) Section 5(a) of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3704(a)) is amended to read as follows:

"(a) IN GENERAL.—There is established in the Department of Commerce a Productivity and Technology Administration, which shall operate in accordance with the provisions, findings, and purposes of this Act. The Administration shall include—

"(1) the National Institute of Technology, whose Director shall report directly to the Under Secretary;

"(2) a policy analysis and information office, which shall be known as the Office of Productivity, Technology, and Innovation;

"(3) the National Technical Information Service; and

"(4) such other agencies, programs, and activities of the Department of Commerce as the Secretary determines should be included within the Administration.".

(b) Section 5(b) of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3704(b)) is amended to read as follows:

"(b) UNDER SECRETARY AND ASSISTANT SECRETARY.—The President shall appoint, by and with the advice and consent of the Senate—

"(1) an Under Secretary for Productivity and Technology, who shall be compensated at the rate provided for level III of the Executive Schedule in section 5314 of title 5, United States Code; and

"(2) an Assistant Secretary for Productivity, Technology, and Innovation, who shall be compensated at the rate provided for level IV of the Executive Schedule in section 5315 of title 5, United States Code.".

(c) Section 5(c) of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3704(c)) is amended to read as follows:

"(c) Duties.—The Secretary, through the Under Secretary and on a continuing basis, shall—

"(1) supervise and manage the Administration and its agencies, programs, and activities; and

"(2) consistent with the provisions, findings, and purposes of this Act and the Act of March 3, 1901 (15 U.S.C. 271 et seq.), cooperate with United States industry to formulate and carry out policies and activities to assist industry to improve its productivity, technology, and ability to compete successfully in world markets.".

(d) Section 5 of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3704) is amended—

(1) by redesignating subsections (d) and (e) as subsections (e) and (f), respectively; and

(2) by inserting immediately after subsection (c), as amended by this Act, the following:

"(d) Further Duties.—The Secretary, through the Under Secretary and Assistant Secretary and on a continuing basis, shall conduct policy analyses and propose public and private actions to improve United States industrial productivity, technology, and innovation. As part of such responsibilities, the Secretary, through the Assistant Secretary, shall—

"(1) determine the relationship between technological developments and international technology transfers and the productivity, employment, and performance of United States and foreign industries;

"(2) monitor and analyze the efforts of other nations to target industries and markets within the United States;

"(3) identify technological needs, problems, and opportunities within and across industrial sectors which, if addressed, could make a significant contribution to the economy of the United States; and

"(4) propose and publicize public and private actions which may improve industrial productivity and technologies in the United States, including policies which make the results of Federally-funded research and development more useful to United States industry;

"(5) propose and support studies and policy experiments, in cooperation with other Federal departments and agencies, to determine the effectiveness of measures with the potential of advancing United States technological innovation;

"(6) provide that cooperative efforts to stimulate industrial innovation be undertaken between the Assistant Secretary and other officials in the Department of Commerce responsible for such areas as trade and economic assistance;

"(7) encourage and assist the creation of centers and other joint initiatives by State or local governments, regional organizations, private businesses, institutions of higher education, nonprofit organizations, or Federal laboratories to encourage technology transfer, to stimulate innovation, and to promote an appropriate climate for investment in technology-related industries;

"(8) propose and encourage cooperative research involving appropriate Federal entities, State or local governments, regional organizations, colleges or universities, nonprofit organizations, or private industry to promote the common use of resources, to improve training programs and curricula, to stimulate interest in high technology careers, and to encourage the effective dissemination of technology skills within the wider community;

"(9) consider government measures with the potential of advancing United States technological innovation and exploiting innovations of foreign origin; and

"(10) publish the results of studies and policy experiments.".

TITLE IV—ASSISTANCE OF COMMERCIALIZATION AND MANUFACTURING

SEC. 401. The Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3701 et seq.) is amended—

(1) by redesignating sections 6 through 18 as sections 7 through 19, respectively; and

(2) by inserting after section 5 the following:

"PROGRAMS TO ASSIST COMMERCIALIZATION AND MANUFACTURING

"SEC. 6. (a) COMMERCIALIZATION AWARDS TO SMALL BUSINESSES.—(1) The Secretary, through the Under Secretary, shall establish a program for the purpose of making awards to United States businesses with less than 500 employees in order to assist such businesses to commercialize new scientific discoveries of great potential economic and competitive value. The awards program shall have—

"(A) a first phase for determining, to the extent possible, the scientific and technical merit and feasibility of proposals submitted pursuant to program solicitations; and

"(B) a second phase to develop further proposals which have shown particular technical merit and feasibility during such first phase.

Where two or more proposals specified in subparagraph (B) of this paragraph are evaluated as being of approximately equal technical merit and feasibility, special consideration shall be given to those applicants who show evidence of funding commitments from non-Federal sources of capital.

"(2) An award made under the first phase specified in paragraph (1)(A) of this subsection shall not exceed

$100,000. An award made under the second phase specified in paragraph (1)(B) of this subsection shall not exceed $1,000,000.

"(b) COMMERCIALIZATION AWARDS TO JOINT RESEARCH VENTURES.—(1) The Secretary, through the Under Secretary, shall encourage United States companies to form joint research and development ventures for the purpose of rapidly creating the generic technology necessary to commercialize new scientific discoveries of great economic and competitive potential value. In addition, the Secretary may provide financial awards to assist in the establishment and operation of such joint ventures.

"(2) No award made under paragraph (1) of this subsection shall be made for more than one-third of the total cost of the joint venture over its lifetime or its first five years, whichever occurs first. No award shall be made for more than five years.

"(3) In determining whether to make an award to a particular joint research and development venture, the Secretary shall consider whether the corporate members of the joint venture have made provisions for the participation of small United States businesses in such joint venture.

"(4) The Secretary may, as appropriate, authorize the participation of the National Institute of Technology in any joint research and development venture created under paragraph (1) of this subsection.

"(5) As used in this subsection, the term 'joint research and development venture' has the meaning given to such term in section 2(6) of the National Cooperative Research Act of 1984 (15 U.S.C. 4301(6)).

"(c) SMALL BUSINESS TECHNOLOGY LEASEBACK PROGRAM.—(1) There is established in the Treasury of the United States a Small Business Technology Leaseback Fund (hereafter in this section referred to as the 'Fund').

"(2) Effective October 1, 1987, there is authorized to be appropriated $50,000,000 for the purpose of providing capital to the Fund.

"(3) The Secretary, through the Under Secretary, is authorized and directed to—

"(A) use capital from the Fund, with the approval of the Secretary of the Treasury, to purchase advanced automated manufacturing equipment made in the United States, particularly flexible manufacturing systems, suitable for use by small manufacturing firms in the United States;

"(B) solicit proposals from United States manufacturing firms with less than two hundred and fifty employees which wish to lease such manufacturing equipment; and

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"(C) lease such equipment to those applicants who demonstrate an ability to use such equipment to improve manufacturing productivity and quality and who demonstrate a willingness to share the expertise they develop through the use of such equipment with other small manufacturing firms and with the Cooperative Centers for the Transfer of Research in Manufacturing created under section 20 of the Act of March 3, 1901.

"(4) The Secretary shall promulgate regulations to carry out the provisions of this subsection, including provisions regarding lease periods and financial and legal aspects of such leases.".

TITLE V—AUTHORIZATION OF APPROPRIATIONS

Sec. 501. The Act of March 3, 1901 (15 U.S.C. 271 et seq.), as amended by this Act, is further amended by adding at the end the following:

"Sec. 21. (a) There are authorized to be appropriated for fiscal year 1988 to the Secretary of Commerce to carry out activities performed by the Institute (other than activities performed under section 20 of this Act) the sums set forth in the following line items:

"(1) Measurement Research and Technology: $48,202,000.

"(2) Engineering Measurements and Manufacturing: $50,615,000.

"(3) Materials Science and Engineering: $26,846,000.

"(4) Computer Science and Technology: $9,727,000.

"(5) Research Support Activities: $21,110,000.

"(6) Research Facilities: $9,500,000.

"(b) Notwithstanding any other provision of this or any other Act—

"(1) of the amount authorized under paragraph (1) of subsection (a) of this section, $9,000,000 is authorized only for the purpose of research in process and quality control and $1,500,000 is authorized only for the purpose of computerized data bases;

"(2) of the amount authorized under paragraph (2) of subsection (a) of this section, $5,000,000 is authorized only for research in automated manufacturing, $2,000,000 is authorized only to adapt Institute automated manufacturing technology to meet the needs of small business and various industrial sectors, $3,700,000 is authorized only for the Center for Building Technology, $5,800,000 is authorized only for the Center for Fire Research, $3,500,000 is authorized only for research to improve lightwave communication systems and related technologies, $3,000,000 is authorized only for the purpose of research to improve bioprocess engineering, $1,000,000 is authorized only for new microwave measurements, and $3,000,000 is authorized only for new research on semiconductor materials, devices, and manufacturing processes;

"(3) of the amount authorized under paragraph (3) of subsection (a) of this section, $3,500,000 is authorized only for the purpose of research to improve high-performance composites;

"(4) of the amount authorized under paragraph (4) of subsection (a) of this section, $1,500,000 is authorized only for the purpose of research in advanced information systems;

"(5) of the amount authorized under paragraph (5) of subsection (a) of this section, $9,213,000 is authorized only for technical competence fund projects in new areas of high technical importance, and $2,610,000 is authorized only for the Postdoctoral Research Associates Program and related new personnel; and

"(6) of the amount authorized under paragraph (6) of subsection (a) of this section, $6,500,000 is authorized only for the cold neutron research facility, and $3,000,000 is authorized only for semiconductor research facilities.

"(c) Appropriations made under the authority provided in this section shall remain available for obligations, for expenditure, or for obligations and expenditure for periods specified in the Acts making such appropriations.".

SEC. 502. Section 18 (a) and (b) of the Stevenson-Wydler Technology Innovation Act of 1980, as so redesignated by section 401 of this Act, is amended to read as follows:

"(a)(1) There is authorized to be appropriated to the Secretary for the purposes of carrying out sections 5, 11(g), and 16 of this Act not to exceed $8,000,000 for the fiscal year ending September 30, 1988.

"(2) Of the amount authorized under paragraph (1) of this subsection, $1,000,000 is authorized only for the Office of the Under Secretary for Productivity and Technology; $4,000,000 is authorized only for the Office of Productivity, Technology, and Innovation; and $3,000,000 is authorized only for the purpose of carrying out the requirements of the Japanese Technical Literature Program established under section 5(e) of this Act.

"(b) In addition to the authorizations of appropriations made under subsection (a) of this section and section 6(c)(2) of this Act, there is authorized to be appropriated to the Secretary for the purposes of carrying out section 6 (a) and (b) of this Act not to exceed $40,000,000 for the fiscal year ending September 30, 1987.".

TITLE VI—MISCELLANEOUS AND CONFORMING AMENDMENTS

SEC. 601. (a) Section 4 of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3703) is amended by adding at the end the following:

"(13) 'Administration' means the Productivity and Technology Administration established in section 5(a) of this Act.

"(14) 'Under Secretary' means the Under Secretary for Productivity and Technology appointed under section 5(b) of this Act.".

(b) Section 8(b) of the Stevenson-Wydler Technology Innovation Act of 1980, as so redesignated by section 401 of this Act, is amended by striking "Director" and inserting in lieu thereof "Assistant Secretary".

(c)(1) Section 5314 of title 5, United States Code, is amended by adding at the end the following: "Under Secretary for Productivity and Technology, Department of Commerce.".

(2) Section 5315 of title 5, United States Code, is amended by adding at the end the following: "Assistant Secretary for Productivity, Technology, and Innovation, Department of Commerce.".

○

Mr. **Skaggs** [presiding]. Thank you, Mr. Ritter.

I'm doing substitute duty as Chair for a little while, while the chairman goes to the Appropriations Committee.

How do you feel your ideas jibe with Senator Hollings' bill to create a National Institute of Technology from NBS and OPTI?

Mr. **Ritter**. Well, I would say that my bill is a much more focused effort. It's a more modest effort. It seeks to bite off a new Federal role in involvement in innovation and industrial competitiveness by starting modestly, by simply expanding NBS to encombinate NBSIC.

As I understand it, there is a whole host of other elements in the Hollings' bill that takes a much more expensive, much more ambitious approach, and that may well be an approach we would wish to consider, but I suspect it would be much more difficult to get off the ground, much more difficult to fund and much more long range in its potential start up.

Mr. **Skaggs**. Given that some of the witnesses that we're expecting to hear from in the next panel are advocating a general expansion of funding levels for NBS without respect to the kind of restructuring and redefinition that you're advocating in your bill, do you feel you can support that regardless of what may happen with your legislation, or how do you rationalize those two?

Mr. **Ritter**. Mr. Chairman, I'm interested in the substance of what we do here and what we provide to NBS, but I must say that over the years that I've been involved with this committee, I've watched NBS lose support in spite of some very substantive contributions. And, I think part of what we're dealing with here is expanding a kind of policy aspect of NBS which will be able to focus on the ideas and the exigencies of global competitiveness in a way that will make the requests for NBS funding more palatable, more acceptable, more understandable by people who don't know what NBS is or where it is.

Mr. **Skaggs**. Thank you very much.

The gentleman from New York, Mr. Boehlert?

Mr. **Boehlert**. The good news is that we've made believers out of some of the others, and I agree with my colleague from Pennsylvania, NBS is extremely important and finally we're getting the funding recommended level moving in the opposite direction, with a 14 percent increase this year. That's long overdue.

Secondly, I'd like to commend my colleague from Pennsylvania for your leadership that you're providing, not only within our party, but within the Congress, on the issue of competitiveness and attacking it in very aggressive form. Obviously, I'm enamored with your piece of legislation because when you told me about it and explained its implications to me, I cosponsored it. So, I want to commend you for your leadership and encourage you to keep up the fight.

Mr. **Ritter**. I thank my colleague from New York, and thank him for his leadership on so many of these issues. We have a real contribution to make here. Everybody is talking about industrial competitiveness. It's the new buzz word in town. It's the new buzz word across the country. But, I guess my question to my colleagues is, what can we do about it here in a way that takes a bit of a jump from the conventional growth curves, a bit of a departure from the

2 percent and the 4 percent and the 6 percent growth. How can we use existing resources to make the leap, and yet, not so overburden the system, or put such tremendous demands on the system, with more blue-sky desires that we turn the system off and we don't get anywhere. So, I believe what we have here is a modest approach to the problem, and something we can do, and we can do immediately.

Mr. SKAGGS. The gentleman from Louisiana, Mr. Hayes?

Mr. HAYES. I had not read the legislation until this morning, and I would like to at this time tell you that I'd be most happy to join in and certainly intend to support it.

Mr. RITTER. I'm sorry? We didn't get you on as an original cosponsor if that's the case.

Mr. HAYES. Most importantly, there's an observation that you make within your statement that's worth repeating for emphasis and perhaps worth stating a little differently. In speaking of the Department of Defense as a catalyst for advances, I think it's of great importance in pursuing this legislation that this is offered as a perspective. So often we line up with defense on one side with the civilian effort, especially in space on another. And, the point that you're making so eloquently is that this bill aims not towards a clash, but offering a different perspective in saying that you don't have to oppose defense and oppose defense spending when you point out that the major emphasis within DOD is not the same as that which could be offered by a different agency.

Mr. RITTER. Exactly.

Mr. HAYES. And you're not meeting heads on. What you're saying is, there's a gap that we have left and that it has to be filled and this is a modest and excellent beginning in filling that gap and offering a perspective for the utilization of research. And, I think that that's important to note, that as this bill progresses, we're not asking anyone to oppose anything, but simply to expand and understand that there are vantage points from which to judge scientific breakthroughs, without making defense the sole area of concentration and realizing the impact on the private sector.

Mr. RITTER. I think that is very true. I think we have witnessed a change in the sources of innovation as the globe, as the world has created new sources of innovation, and as technology has accelerated. It used to be, I mean let's face it, the first computer came out of a University of Pennsylvania research facility that was sponsored by DOD. But, computers are so ubiquitous in the world economy, and there's so much research and so much development, and so much innovation going on, that it would be unrealistic to think that DOD would be, at this point, the prime source of innovation in new-generation computers.

I want to add one thing as I close. People talk about employment in services versus employment in manufacturing. I would like, and I don't have it here with me, but I want to insert it in the record if that's possible, Mr. Chairman, I ask unanimous consent to insert it at this point in the record.

Mr. SKAGGS. Without objection.

Mr. RITTER. An article that appeared in MIT's alumni magazine, Technology Review, and it was by Steven Cohen and Stanley Zeisman, two researchers at the University of California, Berkeley.

They talked about manufacturing and it's impact on services, and they made a compelling case whereby some twice as many jobs that exist directly in manufacturing, in this country, exist in those services connected with manufacturing. And, they defined those services as providing the most high level, most sophisticated, most highly remunerative, best paying in other words, jobs in the service industries; accounting, management planning, management jobs of all kinds, design, engineering consulting, trucker jobs, shipping products, and a whole host of computer services and telecommunications services and information services and financial services that connect up with the manufacturing economy. So, they were talking of some, I believe, 50 million or so additional jobs to those jobs directly involved in manufacturing. That's something for us to consider.

Thank you, Mr. Chairman.

[The Technology Review article to be supplied follows:]

Technology Rev., Feb./Mar '87 v. 90, no 2

The Myth of a Post-Industrial Economy

BY STEPHEN S. COHEN AND JOHN ZYSMAN

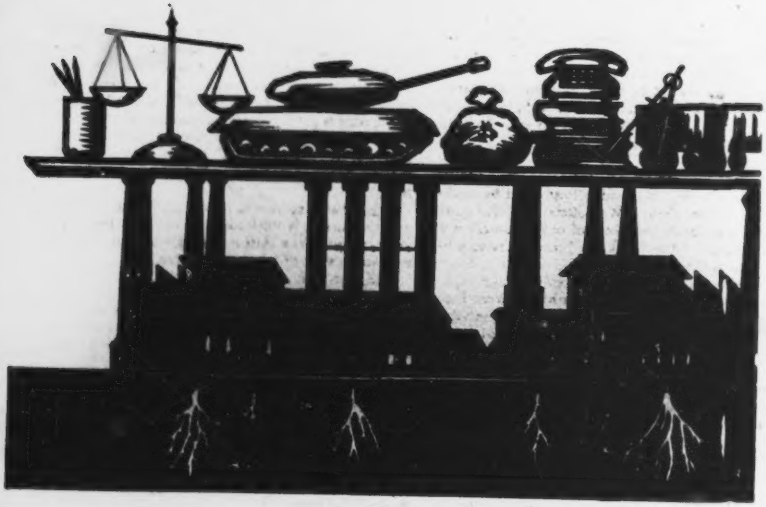
MANUFACTURING matters mightily to the wealth and power of the United States and to our ability to sustain the open society we have come to take for granted. But this contention is a distinctly minority view in the United States today. In part this is due to the power of a central tenet of American economic thought: government policy should be indifferent to what makes up the gross national product.

This conventional view is supported by numerous authors in books, journal articles, op-ed pieces, and expert testimony. They point to the relentless decline in manufacturing employment—from 50 percent of all jobs in 1950 to 20 percent now—and the increase in service jobs, which now constitute about 70 percent of all employment. These figures underwrite the mainstream view that economic development is a never-ending shift from activities of the past up into newer, more profitable activities. The United States shifted from farming to industry. Now we are shifting from industry to services and high technology.

The lesson for government is clear: keep hands off. For example, in his latest Report to the Congress on Trade Agreements, President Reagan sets out the following framework for understanding a troubling trade imbalance. "The move from an industrial society toward a 'postindustrial' service economy has been one of the greatest changes to affect the developed world since the Industrial Revolution. The progression of an economy such as America's from agriculture to manufacturing to services is a natural change."

ILLUSTRATIONS: BRUCE MADDOCKS

The United States cannot afford to abandon its basic manufacturing industries. Relying on a shift to services or high technology is irresponsible analysis and perverse policy.



In a related article in the next issue, Charles F. Sabel, associate professor of political science at M.I.T. and co-author of The Second Industrial Divide: Possibilities of Prosperity, *will write on how West Germany has retained mature manufacturing industries, and how the United States might adapt German strategies for doing the same.*

The New York Stock Exchange, in a recent report on trade, industrial change, and jobs, put it more pointedly: "A strong manufacturing sector is not a requisite for a prosperous economy."

Or, in the words of a *Forbes* editorial, "Instead of ringing in the decline of our economic power, a service-driven economy signals the most advanced stage of economic development. . . . Instead of following the Pied Piper of 'reindustrialization,' the U.S. should be concentrating its efforts on strengthening its services."

In this view, America's loss of market share and employment in industries such as textiles, steel, apparel, autos, consumer electronics, machine tools, random-access memories, computer peripherals, and circuit boards is neither surprising nor bad. It is not a sign of failure but part of the price of success. The United States should be shedding sunset industries and moving on to services and high tech, the sunrise sectors. Such a change is part of an ever-evolving international division of labor from which everyone benefits.

This view is soothing in its message, calm in tone, confident in style, and readily buttressed by traditional economic theory. We believe it is also quite possibly wrong. At the heart of our argument is a notion we call "direct linkage:" many service jobs are tightly tied to manufacturing. Lose manufacturing and you will lose—not develop—those high-wage services. Nor is the relationship between high tech and manufacturing, like that between services and manufacturing, a simple case of evolutionary succession. High tech is intimately tied to manufacturing, not a free-floating laboratory activity.

Our argument takes issue—fundamentally—with the widely articulated view that a service-based, "post-industrial" economy is the natural successor to an industry-based economy, the next step up a short but steep staircase consisting of "stages of development." Because the traditional view justifies economic policies that risk the wealth and power of the United States, it is, for all its conventionality, a terribly radical guide for policy. If the United States wants to stay on top—or even high up—we can't just shift out of manufacturing and into services.

Nor can we establish a long-term preserve around traditional blue-collar jobs and outmoded plants. If the United States is to remain a wealthy and powerful economy, American manufacturing must automate, not emigrate. Moreover, it must automate in ways that build flexibility through the imaginative use of skilled labor. In a world in which technology migrates rapidly and financial services are global, the skills of our workforce and the talents of our managers together will be our central resource.

Linkages and Wealth

Most celebrations of the shift from industry to services construct a parallel to the shift from agriculture to industry. According to that argument, the shift from low-productivity, low-paid farm labor to higher-productivity, hence higher-paid employment in industry is precisely what economic development is about. The same developmental movement, the same "creative destruction," is now being repeated in the shift out of industry and into services and high tech.

This view of economic history, although familiar and reassuring, is misleading. It confuses two separate transitions: a shift out of agricultural production and a shift *of labor* out of agriculture.

The first shift never occurred. U.S. agricultural production did not go offshore or shrivel up. To the embarrassment of those who view the cultivation of large quantities of soybeans, tomatoes, and corn as incompatible with a high-tech future, agriculture has sustained the highest long-term productivity of any sector of the economy. We automated agriculture; we did not send it offshore or shift out of it. As a result we developed massive quantities of high-value-added, high-paid jobs in related industries and services such as agricultural machinery and chemicals. These industries and services owe their development, scale, and survival to a broad and strong American agricultural sector.

Even the employment shift from agriculture merits a second look. The generally accepted figure for U.S. agricultural employment is about 3 million, or 3 percent of the workforce. But this figure arbitrarily excludes many categories of employment. Are crop dusters and large-animal veterinarians employed in agriculture? The 3 million figure is blind to such important economic realities. If we ask what would

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This article is adapted from Manufacturing Matters: The Myth of a Post-Industrial Economy *by Stephen S. Cohen and John Zysman. © 1987 by Basic Books, Inc. Printed by permission of the publisher.*

have happened to employment (and wealth) if the United States had shifted out of agriculture instead of moving labor off the farm, we encounter the notion of linkage: the relationship of agricultural production to employment in tractor repair, ketchup making, and grape crushing.

The more advanced a production process, the longer and more complicated the linkages. Primitive farmers scratch the ground with sticks. They need very little from outside. Their productivity is also very low. Modern farmers head a long, elaborate chain of specialists, most of whom don't often set foot on the farm, yet all of whom are vital to its successful operation and directly depend on it.

Such linkage is not a new notion. But conventional economics does not like linkages to be used as evidence of some special economic importance for particular sectors. Linkage has no place in a discussion of a subject like why manufacturing matters, critics say. Their objection is not that linkages are dubious or rare, or impossible to demonstrate. Rather, it is that they are ubiquitous. In economics, everything is linked to everything else.

Perhaps 60 million U.S. jobs, most of which are counted as service employment, depend directly upon manufacturing.

The linkages admitted in traditional economics are all of the same special kind: they are loose couplings. Each is a simple market relationship between a buyer and a seller, and each involves a traded good. The United States can, in principle at least, make cars or textiles with imported machines. We do it every day, though at a steadily shrinking volume. These are the loosest linkages imaginable.

There are, however, tighter linkages, such as those between agricultural production and the food-processing industry, which employs about 1.7 million Americans. Here the linkages are tight and concrete. Move the tomato farm offshore and you close the ketchup plant or move it offshore also. It is technically possible but economically difficult to mill sugar cane in a country far from the sugar fields, or to process tomatoes far from the tomato patch, or to dry grapes into raisins far from the vineyard. An economy like ours is based on an enormous number of such tight bonds. It is not simply a system of loose linkages like those that dominate the models from which conventional economics produces its conventional prescriptions.

It is extremely implausible that the United States would sustain a major agricultural-chemicals industry if it were not the world's largest and most advanced market for those products. It is not likely that we would have developed the world's largest agricultural-machinery industry in the absence of the world's largest agricultural sector. Were the wheat fields to vanish from the United States, the machinery makers would shrink and so would their suppliers of parts, computers, trucking, and janitorial services.

The Department of Agriculture provides estimates of agriculture-dependent employment, but they outrageously overstate the case by tracing the food and fiber chain up through textile mills and food stores. Their 1982 estimate was 28.4 million jobs dependent on agriculture. Using rather conservative assumptions, we found that 3 to 6 million jobs—in addition to the 3 million traditionally classified as agricultural—can be considered part of this sector.

Manufacturing Linkages

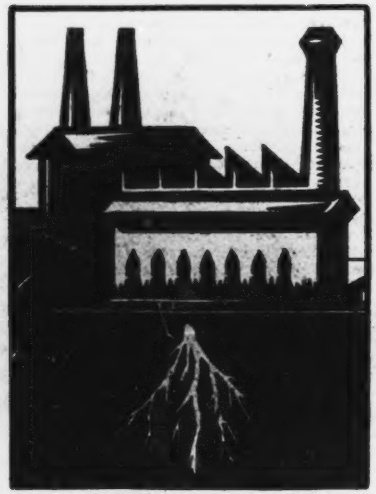
If we turn from agriculture to industry—where direct employment is 21 million jobs—we find that even a remotely similar "linkage rate" would radically alter the place of manufacturing in the U.S. economy. The employment of another 40, 50, or even 60 million Americans, half to three-quarters of whom are counted as service workers, depends directly upon manufacturing production. If manufacturing goes, those service jobs will go with it.

If we lose control and mastery of manufacturing production, the problem is not simply that we will be unable to replace the jobs lost with service jobs, or simply that those service jobs will pay less, or that the scale and speed of adjustment will shock the society—and polity—in potentially dangerous ways. It is that the high-paying service jobs that are directly linked to manufacturing will, after a few short rounds of industrial innovation, whither away, only to sprout up offshore.

Many service jobs that follow manufacturing, such as wholesaling, retailing, and advertising, would not be directly affected if manufacturing were ceded to offshore producers. The same sales effort is involved in selling a Toyota as in selling a Buick.

The services that are directly linked to manufacturing are concentrated in that relatively narrow band of services that precedes it. Examples of such

The U.S. is not shifting from industry to services but from one kind of industrial economy to another.



activities include design and engineering services; payroll, inventory, and accounting services; finance and insurance; repair and maintenance of plant and machinery; training and recruitment; testing services and labs; industrial waste disposal; and the accountants, designers, publicists, payroll, transportation, and communication firms who work for the engineering firms that design and service production equipment.

Two questions pose themselves. The first concerns the nature of the linkages. How can we go about determining how many jobs would vanish from the U.S. economy if manufacturing were lost? The second involves scale: do services to manufacturing constitute a scale of employment sufficient to justify a new set of concerns, a rethinking of theory, and a recasting of policy?

The President's Report on the Trade Agreements Program provides an approximate answer for the second question: "25 percent of U.S. GNP originates in services used as inputs by goods-producing industries—more than the value added to GNP by the manufacturing sector."

But charting how much of this service employment is tightly linked to manufacturing is difficult. It should be right at the top of the economics research agenda, so that it can get to the top of the policy debate. Unless it can be shown that the overwhelming bulk of those services are weakly linked to manufacturing, we must quickly reformulate the terms of that policy debate.

Some of those services that precede are so tightly linked to manufacturing that they are best understood as direct extensions of it. These would include truckers who specialize in shipping raw materials, components, and semi-finished goods. The U.S. textile industry, for example, is a major employer of trucking services. The category of services tightly linked to manufacturing is real, and it is peopled. But unfortunately we do not yet know how big it is.

Is Exporting Services an Answer?

If, indeed, many services are tied to manufacturing, can the United States significantly offset its trade deficit in merchandise by running a surplus in trade of services? Recent experience provides no reason for assuming—wishing is a better word—that the United States is better at exporting services than it is at exporting manufactured goods. The total vol-

If U.S. producers of autos, machine tools, telephones, and trousers don't buy American-made silicon chips, who will?

ume of service trade is an order of magnitude less than trade in goods. Consequently, only a sudden multiplication of service exports could compensate for the present deterioration in traded goods.

There are a number of problems with counting on an expansion in American service exports. First, almost all the current trade surplus in services stems from interest on old loans abroad. These loans are not very bankable since Third World nations threaten to default. Indeed, our obligations to foreign countries now exceed theirs to us. The United States is a debtor nation.

Second, as with domestic services, large segments of trade in international services are directly tied to a strong and technologically advanced manufacturing sector.

Consider U.S. exports of engineering services. These top-of-the-line services are knowledge-intensive and employ highly paid professionals who in turn purchase significant amounts of other services, including telecommunications, data processing, computer programming, and legal advice. Competitive advantage in engineering services depends upon mastery and control of the latest production technology by U.S. producers. Not very long ago we exported such services in the steel industry. Then U.S. steel producers fell behind in the design and operation of production technologies and facilities. When leadership in production changed hands, the flow of services for this industry also reversed. Now we import those services from our former customers in Europe and Japan, and might soon obtain them from Korea and Brazil.

Third, it is not only engineering services that go through this development cycle. Financial services—a sector in which the United States is said to have a strong competitive advantage—are often cited as an area where export earnings could offset deficits in the merchandise account in a big way. Financial services are high in knowledge and technology, and are supposedly located within the most advanced economy: ours.

But the situation in banking services may be less rosy than we like to think. There is no compelling reason to assume a special advantage for U.S. banks compared with their competitors. Foreign banks are bigger, and they are growing faster than U.S. banks. A recent listing of the world's largest banks included 23 Japanese banks, 44 European banks, and only 18 U.S. banks.

U.S. banks are not even particularly succeeding in holding on to their home market. For example, foreign banks are doing as well in California as foreign auto producers. Six of the ten largest banks in California are now foreign owned, up from two of ten five years ago. Foreign banks now account for about 40 percent of the big commercial loans—the high end of the business—made in New York and San Francisco. Service trade is not an alternative to trade in goods.

The High-Tech Link

Some analysts, such as Robert Z. Lawrence of the Brookings Institution, take comfort in the fact that high-technology exports have grown in importance for the United States. They see that as a sign of a healthy, normal development process. But the supposed U.S. advantage in high-technology goods is also deeply misleading. It suggests less a distinctive international advantage than a deep incapacity to compete with our industrial partners even in more traditional sectors. A failure by American firms to remain competitive in manufacturing processes seems to underlie this weakness. Moreover, the U.S. position in high-technology trade is quite narrow and fragile.

In the early eighties the range of high-technology sectors from which a surplus was generated was actually quite narrow: aircraft, computers, and agricultural chemicals. The overall high-tech surplus disappeared by 1983, and in 1984 and 1985 high technology, too, ran a growing deficit. Moreover, a substantial portion of U.S. high-tech exports are military goods, which indicates more about the character of America's strategic ties than about its industrial competitiveness. At a minimum, military sales reflect such factors as foreign policy far more than simple commercial calculus.

Like the service industries, much of high tech is tightly linked to traditional manufacturing. Most high-tech products are producer goods, not consumer items, despite the popularity of home computers and burglar alarms. They are bought to be used in the products of other industries (such as microprocessors in cars) or in production processes (such as robots, computers, and lasers). If American producers of autos, machine tools, telephones, and trousers don't buy American-made silicon chips, who will?

There is not yet, nor is there likely to be in the near future, a post-industrial economy.

A second tie to manufacturing is even tighter. If high tech is to sustain a scale of activity sufficient to matter, America must control the production of those high-tech products it invents and designs—and it must do so in a direct and hands-on way. Unless R&D is closely tied to manufacturing—and to the innovation required to maintain competitiveness—it will lose its cutting edge. For example, by abandoning the production of televisions, the U.S. electronics industry quickly lost the know-how to design, develop, refine, and competitively produce the VCR, the next generation of that product.

Defense: A Footnote

Until now, we have treated military needs in parenthesis, as they are treated in conventional economics. However, it is not easy to make exceptions for something as big as the U.S. military effort. Exceptions of that scale are never without consequences for the rest of the system.

A strong domestic manufacturing capability greatly reduces the costs of our defense effort. Diverse and leading-edge production of technologies such as semiconductors, computers, telecommunications, and machine tools makes the costs of advanced weaponry much lower than if we had to create an industrial structure exclusively for military use.

If U.S. commercial semiconductor manufacturers, say, fall behind foreign competitors, the military might not even be able to produce the components for its own use. Domestic capability in critical links in the production chain—for example, mask-making, clean rooms, and design and production tools for semiconductors—could quickly disappear.

Such an erosion of our ability to produce critical technologies would massively reduce our strategic independence and diplomatic options. Whatever the ups and downs of military spending and the changes in defense strategies, our basic security is built on the assumption that the United States will maintain a permanent lead in a broad range of advanced industrial technologies. Loss of leading-edge capacity in chip making would quickly translate into a loss of diplomatic and strategic bargaining chips.

This argument suggests that commercial development often drives military capability. It is the reverse of the common notion that military needs drive commercial development. If the United States had to support the full weight of a vast arsenal economy, we would become vis à vis Japan not so different from the arsenal Soviet economy vis à vis that of the United States.

Manufacturing and Wealth

Sometimes new notions capture the public fancy, resonate to some element of our experience, and color the way we see the world. The concept of a "post-industrial" society is such a notion. But it also obscures the precise nature of changes in the U.S. economy and what they mean.

Things have changed: production workers go home cleaner; more and more workers leave offices rather than assembly lines. And the organization of society has changed along with the technologies of product and production.

But the relationship of changes in technology and society to changes in the fundamentals of economics—the process of creating wealth—is less clear. There is not yet, nor is there likely to be in the near future, a post-industrial economy. The division of labor has become infinitely more elaborate and the production process far less direct—involving ever more specialized services as well as goods and materials located far from the traditional scene of production. However, the key generator of wealth for this vastly expanded division of labor remains production. The United States is shifting not out of industry into services but from one kind of industrial economy to another.

Insisting that a shift to services or high technology is "natural" is irresponsible analysis and perverse policy. The competitiveness of the U.S. economy—the ability to maintain high and rising wages—is not likely to be enhanced by abandoning production to others. Instead of ceding production, public policy should actively aim to convert low-productivity, low-wage, low-skill production processes into high-technology, high-skill, high-wage activities—whether they are included in the manufacturing unit itself or counted largely as service firms.

America's declining competitiveness is troubling precisely because emerging fundamental changes in production technologies and the extent and forms of international competition are likely to prove enduring. The international hierarchy of wealth and power is being reshuffled, and it is happening fast and now. ☐

Mr. Skaggs. Thank you.

I also thought I remembered signing up for your bill, but if I've neglected to do that——

Mr. Ritter. Well, I would be delighted. We will sign you on forthwith.

Mr. Skaggs. We're going to have a quorum here pretty soon.

Mr. Ritter. Thank you very much.

Mr. Skaggs. Thank you for your excellent statement.

Mr. Skaggs. Our next panel consists of Dr. Lewis Branscomb, Dr. Gordon Millar and Ms. Helen Davis. If you all would please come to the table.

I apologize to Dr. Millar, I was seeing an E instead of an A. Excuse me.

Let me welcome you to the subcommittee, and we appreciate your being here this morning very, very much. If I can offer some special words of welcome to Dr. Branscomb, who barely got here, and also as a former Boulderite, I believe.

Thank you. Dr. Branscomb would you like to lead off with your statement? You may either read through it, or extemporaneously make whatever comments you wish. Your prepared statements will be inserted immediately following your oral presentations.

STATEMENT OF DR. LEWIS BRANSCOMB, DIRECTOR, SCIENCE, TECHNOLOGY, AND PUBLIC POLICY, HARVARD UNIVERSITY, CAMBRIDGE, MA

Dr. Branscomb. Thank you very much, Mr. Skaggs. I shall certainly not read my testimony. It's too long for this format. I'd rather give you a short synopsis.

Let me apologize for being late. I know this committee is not responsible for the deregulation of airlines, and I know our economist friends tell us that market realities will just take care of it, but it's no fun being a market reality.

As you know, I have a long relationship, not only with the Bureau of Standards as its former director, but also a background of 21 years in Government and 15 years as chief scientist of IBM. I'm teaching a course on technology strategies for competitiveness at the Kennedy School at the moment. The subject of this hearing interests me intensely and I congratulate you for having it, and most especially for addressing the Bureau of Standards role. As has been pointed out by others, it is passing strange that the Young Commission could write a report on competitiveness with a very strong emphasis on its science and technology component, and the President could assemble a laundry list of every government initiative he could find addressing competitiveness and the Bureau of Standards seems strangely missing in this litany.

The Bureau, in fact, is making a great contribution today. And, the Bureau could contribute more with the right mission, the right management environment, the right connections to the rest of the technical enterprise, and the resources to do it. But, the Bureau of Standards cannot solve the United State's competitiveness problem. And, it's important—of course, no one agency can. The private sector really has to do it for itself. But, it's important for us to remember that the Bureau of Standards is first, foremost and always a wonderful laboratory, a national treasure, full of scientists and engineers who do technical work every day. It isn't in that sense a general purpose administrative agency well suited to creating programs, managing complex arrangements involving sponsoring of various types of activity in States and elsewhere. It can, of course, contribute importantly to ideas of that sort and it can play a vital supporting role in the development of these new institutional mechanisms.

Unlike the R&D agencies of the Government, and most especially perhaps the National Science Foundation, the Bureau of Standards has always been heavily engaged in all parts of the technology cycle, not just research, not just development, but uniquely in the downstream parts, manufacturing, testing, compatibility, quality, making the pieces of the technical enterprise fit together. A lot of the Standards' activity, a lot of test development, a lot of the Bureau's point of view about quality technical work is of that character. And, since that's the area in which our competitiveness problems in the American manufacturing industry largely lie, the Bureau is indeed well suited to make a contribution.

In addition, the Bureau has always had very close links with industry. A large fraction of its professional staff have worked in industry, and there are microscopic, if you like, or at the level of single individuals, relationships with technical people in industry that run to the thousands, and which give the Bureau of Standards a very intimate knowledge of the way people in industry think, the kind of problems they have, and what are the best ways, genuinely, to be helpful.

Now, I believe that Mr. Ritter and Senator Hollings and others are absolutely right about the importance of manufacturing. In my opinion, the United States has allowed its scientific enterprise to lag until very recently, and there's still a lot of catching up to do, and American product development is being very severely challenged by overseas competitors. But, the place where our companies most frequently get beaten is in design for manufacturability, the speed with which new products are reduced to manufacturing and the quality and efficiency of that manufacturing enterprise. The Bureau of Standards is making a big contribution. But, note we have to also acknowledge that the National Science Foundation is spending about $50 million one way or another in manufacturing related research, and the Department of Defense has made some important contributions to manufacturing technology in recent years and should be encouraged to continue to do so. But, it's a big enough problem, all of our industry, I believe, needs upgrading. There's room for everybody.

But, I would urge you not to think of the manufacturing challenge just in terms of flexible manufacturing systems, or just in terms of computer integrated manufacturing. When industry is in a position to use these modern manufacturing methods, it is because it is possible to do automated design, and to do computer simulation of the designs and test them, and release the designs into manufacturing tooling directly through computer programs. In order to do that, it is essential that you be able to characterize the materials you're using, characterize the processes of manufacture, to have accurate, calibrated knowledge of how the manufacturing tools work, and how you make the tests and measurements to control that system. In other words, the message I'm giving you is, it is the heart of the Bureau of Standards' capability in material science, and in measurement science, in the quantitative management of technology that is at the heart of modern manufacturing, not just the work done in their splendid laboratory that works on robotics, numerically machine tools, and things of that character.

So, in that sense, I think the Bureau has more to contribute to the manufacturing revolution than appears at first glance. And, I think it's very important that as we think about that contribution, we not focus too narrowly, simply on robots or in highly automated manufacturing tools.

The Bureau has also developed, over the years, some unique ways of working with States. I think the National Conference of States on Weights and Measures is something we should continue to remind ourselves about, for this is a voluntary association of 50 States, the Bureau serves as secretariat. It works extraordinarily well. So well, you never hear about it. The Bureau of Standards helps the states draft model State legislation. All 50 States, with great regularity pass it. We have had few disharmony problems in standards among the States, and yet, I would remind you that the very first page of our U.S. Constitution, which we revere so much this year, empowers the Federal Government to dictate how those national weights and measures shall be established. And, the Bureau of Standards has admirably refrained, and the Commerce Department of course, admirably refrained from exercising that authority. I mention that, because I think it's terribly important that the States do get involved in the upgrading of the technology of the firms in their States, and I think the Bureau of Standards knows how to play a very important supportive role to those States that want the Bureau's help.

The Bureau also, as I mentioned before, has an excellent way of working with industry. Sufficiently excellent that you will never hear, at least I have never heard, of the Bureau of Standards' work with industry referred to under the phrase, "industrial policy." I think that's another thing we want to keep in mind, if industry is to benefit from the Bureau's work, it's very important that the relationship be one which industry finds supportive and helpful and not threatening.

Finally, very important to remember that the entire U.S. scientific enterprise depends on the Bureau of Standards, and not just technology and not just industry. So, as we focus on how NBS can help industry, we must not put it in a position where it cannot provide the measurement science support for the progress of science, for if it does, we will be dealing our science a major blow.

Yes, I hope the committee, will consider a plan to increase the Bureau's budget to double its present size. I found it quite astonishing to discover that in constant dollars, the Bureau of Standards' budget has not changed in a quarter of a century. Grant you, to be fair, I picked 1960. It was a peak, after a period of rapid growth. It dropped some from then, it came back up to about that level again, it sagged again. Recently it's been creeping up a little bit. But, America has passed her by in this quarter century. The economy has grown, we've become much more dependent on technology, and the Bureau is still there struggling, not trying to get authority over other people, not trying to take over the world of government, just trying to do a job, I think, in fact, it doesn't have the financial muscle to do even its present mission the way it should be done.

Where would the money be spent? I believe it is essential that no less than 20 percent of the Bureau's appropriated budget be devoted to its own fundamental science and engineering and carefully selected fields designed to guarantee the Bureau that leading edge competence that it requires to be out in front of the pinnacle of American science and the leading edge of American industry. That is not an easy task for a laboratory. And, if it spends 20 percent of its budget on that kind of science, I assure you from past experience, a great deal of practical value will come from it. It won't all be pure theoretical, basic research. But, it should be driven by the investment in the Bureau's competence.

Secondly, I've always believed, and did when I was Director, that the Bureau ought to set a goal for itself of trying to reduce its dependence on other agencies to no more than—I used to say no more than 33 percent, I'll say 30 to make it round numbers. The Bureau serves this central corporate laboratory role for the Federal Government in the physical science, a very important role. But if too much of the Bureau's program is driven by other agency demands, it dilutes the focus on the rather different character commercial technology and its problems have from typical federal technology problems. So, I think we want to put some kind of limit, a self-imposed, self-administered limit on that dependency.

Third, I'd like to make a suggestion that my friends in NBS aren't going to be happy with me about, I dare say. But, I still believe it and have for a long time. If I were going to double the Bureau's budget over the next five years, I would want to see half of the increase, that's a quarter of the total when you get to the end, spent extramurally. Now, why? Not because universities can do the Bureau's work better than it can. In fact, it's precisely because they can't. The Bureau is a 10th of the NSF, which is a 30th of Federal R&D, which is a half of all of national R&D. The Bureau is a tiny instrument within the total national R&D capability. The talent the Bureau has is quite unique. The style of work is quite unique. The whole notion of get it right the first time and get it right in absolute numbers, not just in relative numbers, and pay attention to accuracy and not just precision, that's a scientific and technical point of view. It's not unique to the Bureau, but the Bureau is the one institution where that kind of work is honored and pushed and people who fail that standard are not rewarded. The Bureau needs to contaminate the rest of the scientific community and the engineering community with that attitude towards quantitative work. I can't think of a better way to do that than to try to farm some of its work out in collaboration with others and to build a base of activity outside the Bureau.

Where? Well, surely in universities to some degree, particularly, as they're trying to gear up to understand manufacturing engineering. But, I would say even with the profit seeking private sector. I think there are a number of things the Bureau does which some companies might want to participate in, and there are a number of

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nonprofit institutions like Battelle, SRI and others, that probably also could make an important contribution.

Finally, let me just make a couple of comments about the proposed legislation and I'll rely mostly on your questions. And, let me speak, with apologies to the distinguished House of Representatives, to Senate bill 907, because I didn't get Mr. Ritter's bill H.R. 2068 in time to study it very carefully. I think the idea of the cooperative centers devoted to manufacturing technologies is a good idea, and the fact that they should be located, a number of them, around the country is an important notion. I'm not sure I'm quite so taken with the notion that the Federal Government establishes these centers with the cooperation of States, companies and local entities that agree to participate. I'd kind of rather put the shoe on the other foot. I'd rather take the view that the Bureau of Standard invest substantially in its own deep capability in this technical area. That it spends a good bit of time it will take to augment its staff with people with practical industry experience in the application of these tools. While its doing that, the Federal Government says to the states, those states that organize, in collaboration with your own industry, your own private sector, an approach to upgrading the manufacturing in your State, or in your neighboring states if it's more than one, and you are prepared to create centers that your industry would like to come to and work with, and you establish those centers, we in the Federal Government are prepared to ask the Bureau of Standards to support you with all kinds of sophisticated technical help. I'd really rather put the Bureau of Standards in the position of responding to a state that has worked out the interfaces between the middle size and smaller private companies and the kind of technical support the Bureau can provide. It's a little different in philosophy.

Finally, that bill proposes creating a special administration on productivity and technology in the Commerce Department, a new under secretary, a new name for the Bureau of Standards. There's a long history of proposals to that sort of end, to legislate the Department of Commerce's deeper concern for the technical activities in the Department. If I believed that the Commerce Department really wanted to do that, I would think it would be terrific for you to approve. I'm not sure they do, and I don't think legislating them to care is going to help a lot, particularly after the recent experience of the Department of International Trade and Industry, the DITI proposal which you gentlemen considered. That was actually formally endorsed by the Administration and the Commerce Department seemed quite enthusiastic about it. And, you'll recall that the principal feature, from my prospective at least, of that proposal was to rid the Department of any last vestige of its technical competence. It would have moved the Bureau of Standards and all the other scientific agencies including NOAA, out from the Department of Commerce. With that very recent track record, I'm not sure we should legislate the Commerce Department's enthusiasm for technology. And, I think the committee ought to look at it very seriously. It certainly ought to hear from the Department, but it also ought to look at the relationship between the Bureau of Standards and the National Science Foundation. There is a lot of synergy there too, and my personal belief is that in due course we will work out maybe something less than a marriage, but more than the nonrelationship we have today between those entities. It, of course, has to be looked at in the light of the congressional responsibility of the committees, and in the light of the points in OMB that have responsibility with these agencies. That's one of the reasons, I think, that association might be more valuable.

Thank you, Mr. Skaggs.

[The prepared statement of Dr. Branscomb follows:]

S&T Committee
L.M. Branscomb 3-28

Subcommittee on Science, Research and Technology
Committee on Science Space, and Technology
U.S. House of Representatives

Testimony of Lewis M. Branscomb

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April 28, 1987

Competitiveness: The National Bureau of Standards

Mr. Chairman, I am particularly pleased to appear before the Subcommittee this morning to speak on the place of The National Bureau of Standards in the nation's competitiveness strategy. It is quite remarkable that in all the discussion, from the Young Commission to the President's Competitiveness Initiative, there has been little or no mention of the one institution in our government that has for 86 years, in good times and bad, made such important contributions to the technical muscle of America's industry.

As you know, I worked for the NBS for 21 years, including three as its Director. I then spent almost 15 years as IBM Corporation's Chief Scientist. In that capacity I had the opportunity to learn how an industrial client is served by the Bureau. That service is professional, responsive, and scientifically imaginative. Measurement techniques developed at the Bureau were critical to the solution of some very serious and economically important problems.

There is no question that NBS could make an even greater contribution to the nation's technical capability, given the right mission, the right management environment, the right connections to the rest of the technological enterprise and adequate resources.

It should be equally obvious that NBS cannot be expected to solve our industry's competitiveness problems.

* * *

While the strong dollar, the federal budget deficit, and encouragement of consumption probably are dominant sources of the rapid growth of the trade deficit in recent years, they are not the only source of lagging competitiveness. When the dollar/yen ratio has stabilized, when America's tax and expenditure policies begin to bring the budget closer to balance and begin to favor savings more than consumption we will still have a competitiveness problem.

Proof can be found in the fact that for many years U.S. real manufacturing wages have been falling, and in spite of this unit labor costs have been rising, compared to U.S. competitors. Some combination of quality of management, capital investment in tools, education of the workers and the quality of technology are responsible.

This might be expected if it were occurring in the smokestack industries and were offset by strong productivity growth in the new high-tech industries. But even there, perhaps especially there, it appears many U.S. firms have met their match in the Orient.

Japanese firms often exhibit lower production costs and higher product quality, at least in part because of superior attention to engineering fundamentals: design for manufacturability, quick product cycles and efficient production.

U.S. private industry must respond to these strengths of competitors, and prepare to make the necessary investments both in people and in facilities. Government cannot do it for them. As they do so, they will discover that gaps in our education of both engineers and workers and in the research and experience base in process and materials science and engineering. Production is just not a prestige technical activity for America's technical community, as it is in Japan.

In these areas NBS can be uniquely helpful. And I believe that the effectiveness of that help can be radically leveraged, with the right investments.

* * *

In your letter, Mr. Chairman, you posed two questions:

First, what is required for a 5 year revitalization of the NBS - within its present mission and organization?

Your second question: what are the merits of proposals such as that by Mr. Ritter and Mr. Hollings, (S. 907) which envision major changes in mission, organization, even name for the NBS?

Both questions are asked in the context of the national concern about the technological performance of the private sector. To answer them, we must ask not only what does the nation need, but what are the main strengths and assets the NBS brings to the table.

The NBS already has a vital role in U.S. economic revitalization. As I have said many times before in these hearings and elsewhere, NBS is uniquely concerned with the productivity and integrity of the American scientific and technological enterprise. NSF is much more concerned with scientific discovery and science and engineering education.

The Bureau's research is vital to the progress of science, but it is equally directed to all the other segments of the technological process: development, design, production, testing. NBS does not take that strength or the tone of American technical muscle for granted.

NBS scientists make many outstanding contributions to basic scientific knowledge. But they also take a user's view of science, evaluating world technical literature and preparing it for more effective application. NBS has been working effectively at technology transfer for decades. It is almost the only agency deeply and professionally concerned with the quality and availability of scientific and technical information for applications.

The Bureau's technical philosophy is also uniquely suited to keeping American technical performance the world leader. First is dedication to integrity and accuracy - in other words: getting it right the first time. That is not every scientist's first priority.

Second, because NBS is responsible for the pinnacle of U.S. measurement capability, it focuses on the limits of the technically possible, and how these limits can be reduced to practise in every day work. This means staying up with or ahead of America's leading high tech companies - no mean feat, given NBS' resources.

Third, while NBS focuses on keeping technological efficiency high, its methods provide maximum encouragement to innovation. For example: the Bureau is committed to the merits of performance standards over design standards. No theme of NBS work is more important or less understood. There are powerful forces in our society that keep technologies locked in to outmoded methods and materials because the old way is perceived as serving some group's interests. And the fragmentation of regulatory jurisdiction, for example in the construction industry, makes progress very difficult.

All of these characteristics of the Bureau remind us that it is first and foremost, one of the nation's finest laboratories, populated with scientists and engineers who work at building strong cooperation with the many groups they serve.

Thus we are surely not discussing whether to change the character of the Bureau fundamentally by giving it a range of new administrative and program management functions. Instead we are asking how can its capability be strengthened and even more effectively coupled to other institutions that can work directly with companies large and small all over the country?

Other countries, especially some of the rapidly industrializing nations like South Korea, have been assisted by our government's technical and financial aid to build similar institutions at home, for example the Korean Institute for Science and Technology (KIST) with which to leverage their own development. We know the NBS approach to competitiveness helps. The experiment has been done in Korea.

* * *

Yet the Bureau remains a little known, at least little discussed institution, apparently not even worthy of mention in the President's litany of administration contributions to competitiveness.

Why?

First, the Bureau is a hard working, scientific laboratory. It stays out of politics, can provide few favors for specific congressional districts. NBS is not given to over-promising results that lie beyond its capacity to assure. But despite the Bureau's historic low profile, it is unusual among federal agencies in its close contact with its users.

The Bureau has a wealth of experience in workable, voluntary collaboration with private bodies, state governments and other federal agencies. It has never fought for authority over others, only for the opportunity to be helpful.

As a result, the business community is comfortable with the Bureau's role. For years the technical experts from industry on the Bureau's many technical review panels have urged more congressional support for the Bureau's basic functions. Critics of "industrial policy" can cite the NBS mode of operation as an exemplar of the right federal posture.

I therefore find it hard to understand why the Bureau has not been more strongly supported by the Executive Office of the President during the last 5 years. Even more difficult to understand is why the Bureau's Building Research Center and Center for Computer Science and Technology have been so persistently served up for reduction or elimination. Both are excellent examples of technical programs aimed at increasing the private sector's capability to innovate and at helping state and local regulatory authorities remove inappropriate constraints on innovation.

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Mr. Chairman, you have raised the possibility of Congress authorizing a doubling of the NBS budget, as the President has requested for the National Science Foundation. This idea deserves the most serious consideration. The Bureau's scientific and technical research and services budget is today barely what it was a quarter century ago, in 1960. This is truly astonishing, and suggests to me, that the nation does not have a technology strategy at all.

I appreciate that NBS operated for many years with a continuing authorization, without annual presentations of its plans to the committees with legislative oversight. Today I am glad to see those annual presentations are made, which I am sure is helpful to the appropriations subcommittees. But I believe a five year authorization for NBS as well as for NSF would lead to much more serious long range planning at NBS, and thoughtful commitments on both sides to a set of investments and a set of expected accomplishments. It would be entirely in keeping with the Bureau's apolitical nature.

How might increased budgets for NBS be invested?

I have not made a study of the NBS budget, so I cannot be precise. I can provide some general guidance, based on judgement, not analysis.

First, the Bureau must maintain balance in its obligation to its own competence, its service to other government agencies, and its research operations and service functions.

I suggest that the NBS never invest less than 20% of its research budget (and the Competency Fund) in fundamental science and engineering on topics carefully selected to build the Bureau's skill, attract the best talent and prepare for difficult mission-specific tasks. Much of this work can be counted on to pay off handsomely with practical value.

Second, the Bureau should set as a management target a ceiling of 30% on other agency funding dependency. These programs recognize NBS as the analogue to the Government's corporate research laboratory; the function is important. The Bureau can manage higher levels than that, but with the danger that the style and content of NBS research is drawn away from the private sector's technological interests.

Third, the bulk of the remaining funding should support high quality research and evaluation activities in response to priorities that assure support both to the progress of science itself and of technology.

* * *

I would like to speak to two areas in particular: scientific and technical information and technologies related to design production and test.

Now is the time for reversal of the administration's disinterest in scientific and technical information services, which are the mechanism through which much of the government's R&D investment reaches and services the economic interest of the nation. There as been much hand-wringing about the skill and speed with which foreign competitors collect and organize information from the open institutions of American fundamental research. It is no less than astonishing that our own government seems content with paying for the research but cares little about organizing access to it by firms and institutions in this country.

Indeed, we should be moving the other direction - organizing to collect and disseminate open technical information from the research in competitor countries. The Japanese have been urged by the U.S. to expand their contributions to science. They are going to do it, and do it very well.

This is not just an NBS problem, but a nation-wide matter calling for collaborative efforts from all agencies and all sectors. We should not be debating contracting out the NTIS. We should be debating building a Scientific and Technical Information Policy appropriate to nation that believes technological performance is key to competitiveness.

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On the manufacturing issue, Senator Hollings is correct to the place the emphasis he does on this area. Many people seem to assume that if you address problems in R&D you have covered the technical issues of competitiveness. Nothing could be further from the truth.

But it would be a mistake to concentrate too much on the specific issue of computer integrated manufacturing, robotics and the like. Design for manufacturability is at least as important. So too are the matters of materials and process characterization and the testing, all of which put great stress on advanced measurement capability.

If automated designs are to be released directly to automated plants through computer programs, much more accurate and complete knowledge is required of the properties of the materials being used and the processes to which they are subjected. Accurate testing becomes more important as control of the processes must be tightened and as productivity depends so critically on process yield at every step.

Thus it would be a mistake for either the congress or NBS to think of the production productivity gap as a robotics problem or even a CIM issue. Virtually every area of the Bureau's main mission is called out for challenge in these new production environments.

I am sure that a major increase in resources would be necessary to allow NBS to make balanced contributions to a number of key industries.

* * *

The next point I must address is how might the Bureau carry out an expanded program with maximum leverage and effect.

Two issues arise: NBS support of extramural research and NBS relations with the states.

NBS needs additional resources to insure a first rate job on programs they are already committed to. But I believe that neither the nation nor the Bureau should be content with the current rate of diffusion of the kind of technical knowledge the NBS fosters. The Bureau's budget were to be doubled, and half of the growth (25% of the final total) should be reserved for carrying out projects in carefully chosen universities, not-for profit laboratories (like Batelle and SRI), and in for-profit companies interested and qualified to contribute.

This will be an unpopular recommendation at NBS, although I have made it before. But we must remember that NBS is only 1/10 of the NSF, which is only 1/30 of the federal R&D budget, which itself is equalled by private R&D investments. The Bureau must find a way to draw on these other R&D resources which are so very much bigger, and often less critically invested.

The second argument for this "out-of-house" program relates to human resources. If this kind of quantitative, accurate, industrially important research is unique to the Bureau, where is industry going to find people to hire who have this kind of training? We must imbue these attitudes and skills in our engineering schools and applied science departments. This is the best way to help industry; it is the help industry most welcomes.

Finally, it would be wrong to ignore the extraordinary prominence federal competitiveness policy today is giving to the universities. The NSF Engineering Research Centers and the new Science and Technology Centers are expected to provide the common ground where industry draws on the leading edge work funded by the federal government with competitiveness as the objective. NBS cannot, at least should not ignore this mechanism, but should participate it in it, as the Stevenson Wydler Act envisioned 8 years ago.

* * *

Next is the matter of the states, which are to play an important role in the vision of S.907. I do not care for the way in which the new institution set up by S.907 describes the establishment of the "cooperative centers for the transfer of research in manufacturing". I prefer an approach in which NBS sets out first to demonstrate deep technical mastery of the many facets of manufacturing technology, emphasizing the characterization, control, testing and specification skills that are the NBS hallmark. The states should be told: if you succeed in putting together an effective program for helping firms in your state modernize their production and its technology, and you are ready to use the kind of high level technical support NBS can provide, the Bureau stands ready to provide it on request.

The cooperative centers proposed might be quite useful, especially as training facilities. They might best be placed in engineering schools convenient to a group of neighboring states. But NBS should give maximum encouragement to companies readying themselves to offer turn-key manufacturing systems services. There are few such companies today. It is not an easy business. But if modernization is going to move at an acceptable speed it will have to be driven by entrepreneurs willing to take much more responsibility for their client's production problems than any cooperative center with federal participation could ever do.

* * *

Finally, I owe you a few other comments:

I welcome the idea of giving NBS more visibility, perhaps even with a new name.

I also welcome the effort to institutionalize in Commerce a stronger commitment of departmental attention to matters of science and technology and the idea of pulling several related functions together to this end.

But to be honest with the Committee, I am not optimistic about the results. For I am not persuaded that the leadership of the department - or even the proposed new Undersecretary of Productivity and Technology, will understand that the Bureau (or NIT) is a scientific institution with important human resource responsibilities. Its products are not always easy to measure, or even find. This kind of institution is often frustrating for impatient, business experienced executives.

The temptation will be to try to find more quantitative measures of output, to be more formal about the technology transfer arrangements, to prove that these measures are making a direct and immediate contribution to reducing the trade gap.

But every step in that direction runs the danger raising "industrial policy" concerns in the business community, and of weakening the Bureau's commitment to the highest quality programs.

I cannot prove the Commerce Department cannot or will not operate as one of the executive branch leading scientific and technological departments. It should, and perhaps one day it will. But very recently the DITI proposal - also advanced in the interest of addressing trade concerns - would have divested the department of all its technical capability including NBS.

Thus I think the Department and the President must be persuaded that this is the correct move, that it should be prepared most carefully in collaboration with the Congress.

For the opposite alternative may be equally or more attractive: associate the NBS with the NSF in a carefully structured partnership, just short of a marriage. It is not clear to me where the natural forces are more likely to yield the desired result: a vital, imaginative U.S. manufacturing sector, drawing on the nation's best science and technology and staffed with well trained and motivated technical people.

Mr. SKAGGS. Thank you, Dr. Branscomb.
Dr. Millar?

STATEMENT OF DR. GORDON MILLAR, CHAIRMAN, PANEL ON THE NATIONAL ENGINEERING LABORATORY, NATIONAL ACADEMY OF SCIENCE, WASHINGTON, DC

Dr. MILLAR. I don't promise you the eloquence of your first presenter, but I'll share with you some of my experiences with the Bureau.

First, let me tell you a little bit about myself. I'm retired from Deere & Co., where I served over 25 years, most of that time as vice president for engineering, and responsible for the designs and the activity which created the products which are suspect today as being in the target zone for lack of competitiveness. Since retirement I operate a small venture capital company, so in some respects I've gone from major industry to small business.

The real reason I'm here is that I've served for the past 6 years on the National Research Council Committee for evaluation of the Bureau of Standards and chaired the panel which evaluated the National Engineering Laboratory. I appeared before this committee in about this same time, I think it was the 3rd of March in 1984, and presented to you at that time, my evaluation of the Bureau, which was characterized in our report as a unique resource of our Nation, a resource that should be supported, a resource of high technical competence and superb facilities. And, that characterization of the Bureau was conveyed to you in a report, this green covered report in 1984, a substantive report which was not appreciably different than its evaluation of the Bureau in 1985 and this report which was released less than a month ago, is our evaluation for 1986.

In addition to that document is a piece of written material which unfortunately was delayed in getting here, which I understand you now have available to you, and it characterizes some of my thoughts on the other issues, other than just how we should deal with the Bureau, and a small document that also supports my concern with the fact that we must adopt a common system of measurement, and in view of the fact the rest of the world has adopted the metric system, I support that adoption.

So, let me just touch on one or two of the highlights of the presentation. I see no point in reading something that is on the printed page, but let me at least share with you some of my thoughts that I've been asked to do so.

First, I was asked to deal specifically with three things in Chairman Walgren's letter of invitation. First of all, the National Bureau of Standards is the focal point for promotion of and improving manufacturing competitiveness in the United States, the first issue. Second, is the reorganization of the Federal Government regarding how we deal with the Bureau. And, then thirdly, the whole concept of manufacturing centers, centers that would deal with the small businessman and make available to small business information, and in some cases some kind of a lease arrangement where equipment that might be involved in automation, such as robots, or

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whatever you choose to do, to make our small businesses more competitive. Now, let me deal with each of those independently.

First, as far as the Bureau is concerned, I have said before, and I reiterate again, and I refer you to the reports which we wrote in 1984, 1985 and 1986, I think the Bureau is underfunded. And, I think that anything that you do to raise the funding level will be, not only in the national interest, but certainly in the interest of competitiveness in the United States as characterized by the relationship between manufacturing, the manufacturing industries and the Bureau of Standards. As a practicing manufacturing executive, I used the Bureau often, in fact, brought the first project to the Bureau in 1957. And, I've been involved from the civilian sector with the Bureau of Standards ever since.

It might be of interest to you and others that the National Engineering Laboratory absorbed in 1986, some $48 to $50 million of the total budget of the Bureau which is in the range of $110 to $120 million. Interestingly enough, dollar for dollar, industry supported the National Engineering Laboratory so that, in fact, they operated on a real budget of something in the range of $90 to $100 million. And that support from the industrial sector, by itself, is a characterization of the worth which the private sector holds the Bureau of Standards. The Bureau in the past 5 to 10 years has gotten very deeply into the manufacturing activity. The automated manufacturing research facility had its debut last October. Some of you may have been there and visited the facility. That's available to industry currently today, in order to help industry solve some its manufacturing problems. So, the Bureau of Standards stands virtually alone in our United States as an integrated activity that combines science, technology, engineering, all the management skills in the creation of the science that is necessary to put in place the metrology, the measurement processes that we need in order to operate in the new global markets.

So, I think that part, that whole aspect of the Bureau of Standards, in my judgment is in place. I think that it functions well within the Charter which was drafted in the year 1900, and I can only say that, at this point, that the activities of it should be funded to a higher level. Within my written comments I point out that the Center for Building Technology, the Center for Fire Research in the past several years have been cliff-hanging operations. The people that work there should be given very high marks, because every year they lived under the threat of having their budget totally cancelled and only at the 11th hour were the funds restored. In my judgment that just is not good management, and I think that anything that you, as a committee, can do to restructure that whole process, so that the people within the Bureau are given the assurance, in fact, that this committee and the Congress and the people of the United States recognize the worth of the Bureau, and would have made a major contribution to improving the performance of the Bureau, which is already at a very high level.

Now, with regard to the organization, I am far less skilled in government affairs than in the private sector, and I'm not as comfortable in sharing with you how I view the reorganization, the changing of the name and things of that general nature.

My first reaction was that it would not be in the best interest of the Bureau to change its name simply because that might imply a major change in mission, which obviously it would, and I haven't thought through yet whether that's really what we want to do. But, as going back through the reports of which I was the author, it has been suggested for the past several years that certainly the mission be studied.

Now, where I find myself not totally understanding the problem, is the fact that where I had anticipated the Bureau's mission might be broadened in a scientific and disciplinary way, I think there's some question whether you really want to use the word competitiveness. You have to remember that competitiveness in many respects is dictated by the customer, and that force-feeding technology, force-feeding manufacturing skills and so forth, into an industrial activity, doesn't guarantee that you have a product that's in demand by customers in a global market. The real thing that we have to deal with in competitiveness, is beginning to embrace the concept of total quality.

While we monkeyed around for years in manipulating the business aspect of the manufacturing process, we really let our Japanese friends get the jump on us with regard to defining the manufacturing process as a total activity of excellence, from concept of the product to delivering it in the hands of the customer. Now, we have not done that in the United States. And, I've heard Congressman Ritter and others say, and this is not anything I've invented, but they've said that, you know, we really do a good job in research. And, I think that's true. Our universities are the finest of any nation in the world, and the fact of the matter is, we like to think in the private sector, that we do a good job with product development. And, I think we do a job in many other things, but the missing link is how you convert all that activity into products which are in demand in global markets. It doesn't do you any good to build products if you don't have customers, and what we lack in the world are customers. And, the reason you don't buy a product isn't because the people involved had robots, or had automated machines, or whatever, it's because the product doesn't satisfy the customer need. So, you have to begin to think in terms of a whole integrated policy.

In this statement, I made a comment, and I don't mean to be cute about it, but if you really want to know how to spell competitiveness, it's total quality. It's the product, in the long run, that's in demand by the customer that makes you competitive. It's not a push proposition. It's a pull proposition. And, how you deal with that in the legislative effort, and how you put investment on the part of the Government to create a market and create customers which is really what you need to be competitive, is the question that I have to say is beyond my scope of understanding right at the moment. But, that is something that we clearly have to do.

Now, with regard to the centers of manufacturing and that whole activity, again, I think I'd have to take somewhat of a neutral view. At the present time, as a kind of a hobby company, I'm involved in a small company. We make precision parts and we're a company in the $25 million range. We employ some 200 people. But, interestingly enough, we view our competitive markets as purely domestic. Our customers are in many cases larger companies, in many cases we have a proprietary product which we market in local areas, and I don't really see at the moment how having available to us a line of credit, if you would, to put in place robots or other kinds of machines, would really effect our competitiveness. What would be important to us, might be to have a source of information. And, I might refer you to a little organization in Dearborn, and I think it's called the American Suppliers Institute, which we go to from time to time to get information on how to deal with the manufacturing act, how in fact, to introduce some of the things that come out of the AMRF and how to brace up our manufacturing so that we are more competitive.

I'm not at all convinced that having centers managed by the Federal Government, in conjunction with the State or any other way, that would in some way make available to small businesses the physical machines, if you will. I think I saw the word "leasing" in here someplace. I really don't think that's going to go a long way to solve the competitiveness problem. What we're really dealing with in the whole competitiveness activity is a change in the manufacturing culture and the business culture of our nation. One of the reasons the Japanese have been so enormously successful in marketing products is because they looked at the entire process, from concept through customer satisfaction, integrated that into a business plan that accurately anticipated the needs of the customer. So, we have to be very careful that we don't just focus on the transformation act, the act of converting raw material into final product and say, that's manufacturing. That's not manufacturing, that's just transformation. The true manufacturing concept is the Deming, Taggucci, Willoby, Template kind of thing, which really looks at the whole process, and I urge this committee to take that into consideration before you write legislation that says in effect, we're just going to look at robots and fancy little devices in a very limited away. I think that would be counterproductive.

I don't know what more I could add that you can't read in here. My present association, I think as you know, is with Southwest Research Institute. I manage their Detroit office and a whole host of things since I retired from the private sector. But, Chairman Walgren, I'm pleased that you invited me to be here. I want to say that having served for 6 years on the committee to evaluate the Bureau has been 6 years that I've enjoyed enormously. I hope finally, that the three reports which we've written and I've written as chairman, are beginning to get some attention. There's 75 of them here. We print about 500 a year, we end up with 400 left over, so to get rid of 75 would be a step in the right direction. We have some left over from 1985, we have some left over from 1984, and they're free. So, I'll be happy to answer any questions that you might have.

[The prepared statement of Dr. Millar follows:]

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25 April, 1987

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Member National Academy of Engineering

The Honorable Doug Walgren, Chairman
Subcommittee on Science, Research and
  Technology
Committee on Science and Technology
U. S. House of Representatives
Washington, D. C. 20515

Mr. Chairman and Members of the Subcommittee
  on Science and Technology:

I am pleased to be invited to testify before your Committee on behalf of a national effort to increase global competitiveness of United States manufacturing. My name is Gordon H. Millar. I retired at the end of 1984, as Vice President of Engineering for Deere & Company in Moline, Illinois. In the intervening years I have been involved as President of the Accreditation Board for Engineering and Technology, President of a small venture capital manufacturing company, and as of the beginning of this year as Executive Associate of Southwest Research Institute in San Antonio.

For the past 6 years I served as a member of the National Research Council's Evaluation Panel for the National Engineering Laboratory of the Bureau of Standards. For three of those years I served as Chairman of the Panel and am author of the National Research Council Reports of the National Engineering Laboratory for the years 1984, 1985 and 1986.

As part of this Testimony, I include the 1986 NRC Report on the National Bureau of Standards, National Engineering Laboratory. The full report is an evaluation of the performance of the NEL including the AMRF (Automated Manufacturing Research Facility).

Of special importance to this Committee are the first 7 pages of the Report which warrant your attention. They spell out the Committee's views on how the overall performance of the NEL could be improved. I appreciate that legislative matters take a considerable amount of time, but I feel obligated to report to this Committee that the recommendations in the 1986 Report are not appreciably different than the 1985 and 1984 Reports. The Chairman's Overview of the 1984 Report was included in Testimony I presented to this Committee on 3 March, 1985.

In addition to the 1986 NRC Report on the NEL of NBS, I also include a document giving my views on the need for our United States industry to embrace systematic adoption of the metric system of measurements. This is a means to eliminate one form of non-tariff barriers to the importation and use of United States manufactured products in countries outside of North America.

Your letter of invitation asked me to specifically discuss several items associated with a process for reinvigorating the National Bureau of Standards as the focal point for promotion of and improving manufacturing competitiveness in our United States. The request also asked that I comment on the reorganization of the Federal Government regarding industrial research and development, and technology transfer of Government intellectual property and competitiveness. I will try to make my view of our national industrial activity as clear as possible and to distill for you recommendations for legislative action, which in my judgment will improve the manufacturing atmosphere in our North American industry.

First, let me deal briefly with how I view the problem and what I think is necessary for us as a nation to regain our rightful role in global markets.

For the first half of this century our nation went unchallenged as the most innovative, scientifically based manufacturer of industrial and consumer goods marketed wherever civilization flourished. Not long after World War II while we as a nation became preoccupied with the financial and business management of our activities, our offshore competitors pursued a path of product design and manufacturing excellence which allowed them to encroach not only on our traditional domestic markets but on those markets in which we participated in the offshore environment.

As business managers, we used every excuse to explain our increasing loss of competitiveness in markets dominated by science and technology-based products. You have all heard the arguments of labor rates, material costs, management style and the inflated foreign currency-dollar exchange rates. Systematically in the past several years these perceived deterrents to competitiveness have been reduced, and even eliminated. In the most recent years the change in exchange rate has reduced the value of the dollar in the Japanese market by more than 50%. These changes have had little, if any, influence on how truly competitive our products are in global markets.

Nothing is absolute, and certainly the items cited in the above paragraph plus some of the non-tariff barriers imposed by our trading partners have had an influence on the balance of trade, which for the most part is unfavorable from our point of view. The truth of the matter is that in recent decades we have devoted our energy to practically every activity other than concentration on the integrated design, manufacturing and customer satisfaction excellence which is the true heart of competitiveness. This profile of activity is characterized by the Deming-Taguchi Concept of Total Quality and is an absolute essential if we as a nation are once again to become a factor in the global market for technology-based consumer products.

I suggest that the answer to the question of 'how do you spell competitiveness?' is TOTAL QUALITY. With this brief preamble, let me deal more specifically with the issues that you have asked me to discuss.

The first question is whether increasing the budget of the National Bureau of Standards will help improve and be advantageous to improving the manufacturing environment in our United States. As I have reiterated for the past several years in the NRC publication reports of the NEL of NBS, it is my conviction that funding for the Bureau of Standards must be increased if we are to maintain an ongoing source of fundamental metrology essential to the support of manufacturing in the United States. To what level this activity should be supported is dependent on how the mission of the National Bureau of Standards is defined.

It has been a cliche for years that something is or is not engraved in stone. It might come as a surprise to this group that the mission of the National Bureau of Standards articulated 14 May, 1900, by the Congress of the United States says in part"...no more essential aid could be given to manufacturing commerce, the makers of scientific apparatuses, the scientific work of the Government of schools, colleges and universities than by establishment of the institution proposed in this Bill." The Bill proposed the creation of the National Bureau of Standards. It may further interest this Committee that these words are engraved in stone carved into the marble walls of the Lobby of the Administration Building of the National Bureau of Standards, Gaithersburg, Maryland location. If anyone ever doubts the vital nature of our nation maintaining a sound technological and scientific metrology base in the support of industry, they should simply visit the Lobby of the Administration Center of the National Bureau of Standards and read the declaration.

The mission of the NBS is clear that it was conceived and it has been directed to support commerce and manufacturing in our country. As recommended in our 1986 Report, it is the unanimous opinion of our Committee that this mission should be reviewed and expanded to embrace a new and developing perception of how science and technology influence our manufacturing competitiveness.

With this thought in mind, I fully support an increased funding level of the Bureau of Standards. Whether this should be a doubling of the budget in 5 years as proposed by Senator Hollings or whether it should be a restructuring of NBS activities in a more focused way and within a more limited funding profile is a question that requires some fair amount of study. It can, however, be easily determined once we agree that the development of scientific and technologically understanding in the creation of manufacturing standards is an essential part of the competitiveness formula.

There is no question that investment on the part of the Federal Government in the development of industrial standards and associated activities which will embrace the concept of TOTAL QUALITY from concept through customer service is an absolutely essential ingredient to regaining competitiveness in global markets.

As part of the first issue I have been asked to comment on the use of metric measurement or conversely the continued use of English-based units in our domestically manufactured products. Enclosed as part of this Testimony is a brief essay I presented about a year ago here in Washington as the Keynote Speech to the American National Metric Council.

For practical purposes the speech contains nothing new. I am not impressed by anything unique about the metric system or the English-based system or some other system not yet invented. What is important is that as a nation we embrace a measurement system and adopt industrial standards within this measurement framework which will not permit offshore competitors to create non-tariff barriers to use of United States manufactured products within their community. To achieve this end we no longer have a choice. We can spend valuable time in oratory and debate, we can fuss and fume about a "foreign system," we can rise up in protest about having to change some of our traditional domestic measurement styles, but if we truly intend to compete, we must embrace the common measurement system used virtually throughout the world with the exception of the United States. I do not care whether this system is metric, English, Martian, or whatever, but it is foolhardy to stonewall an isolated measurement position and jeopardize our return to a global competitive status by doing so.

I embrace and urge the adoption of the metric system in these United States for no other reason than to eliminate a negative force to our global competitive formula.

The second item I have been asked to comment on is the reorganization of the Federal Government with regard to industrial research and development. Senate Bill #907 proposes the creation of a National Institute of Technology which would be built on the foundation of the National Bureau of Standards and the office of Productivity, Technology and Innovation and create a single component. It is my understanding this new organization would be within the Department of Commerce and be headed by a new Under-Secretary of Commerce for Productivity and Technology.

I have had very little time to study this proposal, but I believe on the surface, at least, it has some merit. Since my involvement with the National Bureau of Standards as a member and as Chairman of the National Engineering Laboratory Panel of Assessment, I have developed a growing concern that the NBS has been treated shabbily. In fact, for the past 3 years our Report has pointed out the demoralizing effect of a capricious and almost willful budget activity that during the initial budget process eliminates funds for the Center For Building Technology and the Center For Fire Research only to have those funds restored by Congressional decree at the 11th hour. I can only admire the resiliency and the faith of the scientists and engineers who commit their careers to effort in these areas and are willing in the interest of our nation to perform to a very high level of scientific and technical excellence in such an uncertain environment.

If a new organization can and will provide a high level of competent leadership and a reasonable process for funding decisions, then as an individual practicing engineer and a citizen I cannot object to and support the formation of a new organization.

On the other side of the coin, if the formation of the National Institute for Technology were to simply establish a new bureaucratic process and generate new layers of managerial obfuscation, then I would rather support increased funding of the National Bureau of Standards and develop a new reporting status directly to the Secretary of Commerce. I do take heart in the fact that Committees like this Committee today understand better than ever the fundamental role science and technology play in the health of our nation. I accept at face value the seriousness and intent of your effort. With this background and allowing me the caveat that I give this opinion with no real knowledge of the details of execution, I support and embrace a new, more visible organizational arrangement that would move the NBS to a higher level in our Federal Government which would demand the attention of our elected legislators and their appointed secretaries.

I have also been asked to comment on a host of proposals to deal with technology transfer, Government intellectual property and competitiveness. I find this particular issue substantially more difficult to assess than the funding level required by NBS or reorganization of our technical activities. From what I have read, it appears that what these several proposals would do is to put in place a mechanism that would make available to small businesses a higher level of manufacturing scientific and technical expertise that individual small businesses might not be able to afford without outside help. The help profile would include the leasing of flexible machining centers, the training of managers and engineers, the use of historically proprietary technical information and other activities associated with bracing up the competitiveness of our emerging small business environment.

On the surface these activities would appear to have merit. What worries me is that the unique characteristic of business in our United States is predicated on a fierce level of entrepreneurship and a high level of competive sense within competing industries of our nation. Our new objective in what we do as a nation is to convert the energies generated in the small business sector to meeting global competition without harming our internal domestic relationships. It strikes me that any businessman large or small who truly embraces a global competitive posture will very rapidly find out what it takes to accomplish this task. The problem is not so much that the small businessman won't embrace new technology; the real problem is that survival of the small businessman is so far still perceived as a domestic issue. The customers of the average small businessman in the United States are for the most part the larger manufacturer or in many cases a domestic line of products. By introducing new technology to the small businessman, we may well make them more competitive amongst themselves and by providing lower cost components to more major manufacturers contribute in a way to global competitiveness. I would be surprised if the average small businessman operating on a day-to-day basis could and would make that association.

I have no objection to the creation of centers for manufacturing excellence. The engineering directorate of the National Science Foundation of which I am a member of the Advisory Board has created 11 centers for engineering research at the university level. In my judgment these centers have been successful. I would hope, however, that we go about this program in a way that makes it easy for the small businessman to embrace the concepts of the program, and that as participants in the Federal Government we don't expect overnight results.

We have become a very close-coupled nation. We tend to want immediate results and believe that if we invest sufficient resources consisting mostly of money into any particular activity, success is assured. I caution everyone concerned with this activity that results from the influx of funds to centers of manufacturing excellence for small business is not an overnight project.

As a nation we are dealing with some fundamental cultural changes. Although I support this activity as in the right direction, I also suggest that we develop a posture of patience and willingness to teach as well as learn. Results will come from changes in our industrial culture not from the simple act of putting a robot or flexible machining center or a computer-aided inspection and reporting system into any specific business. If we are willing to create these activities on the above basis, then we should do so, but we should be prepared to do so at least over a 5-year period or probably longer. Help is defined by the recipient.

Chairman Walgren, Members of the Subcommittee, I am pleased to have had this opportunity to present my views and wish you success in your endeavors.

Gordon H. Millar

GHM/vmm

Keynote Address delivered to the American National Metric Council
22 September, 1986 - Washington, D. C.

Mr. Chairman, Participants in the American National Metric Council, Ladies and Gentlemen:

It is a special pleasure for me to have this opportunity to reiterate for you my long standing support for the adoption of the metric system by United States industry. As powerful as our nation is and as technologically competent as we are in industry, it still is of the utmost importance that we communicate rapidly, accurately and competently with our industrial associates and, in particular, our customers in the new and emerging offshore markets which make up our new global community.

For several years now, I have been away from active participation in the introduction of the metric system to Deere & Company operations. As many of you are aware, Deere & Company expanded in the late 1950's to begin operations outside of the United States. Manufacturing operations were acquired in several West European nations and marketing outlets and assembly operations developed in Latin America and other parts of the free world.

Throughout this expansion process and as a result of the economic need to rationalize product design, Deere became immersed in the problem of converting drawings from English units to metric units, or in some cases, converting European drawings of metric parts to English units for manufacture in the United States. The problem was compounded to some degree by the fact that drawings also had to be converted from first angle projection to third angle projection, which for those of us trained in the art and practice of conventional drafting was not a natural conversion, no matter what our starting point.

As more and more technical exchange developed between organizations and individuals trained in English units and organizations and individuals trained in metric units, it became increasingly clear that some systematic way had to be developed to enhance our ability to exchange information and to accurately convey engineering specifications and dimensions between operating units.

The difficulty of this relationship was further compounded by the use of different languages and the cultural differences between practicing engineers in various countries.

As time went on, we began to work around the problem through the use of dual dimensioning with development of common drawing notations in several languages and a host of other practical means to minimize the impact and cost of operating in a multi-cultural engineering environment.

For most of the decade of the '60s, these relationships became more finely honed; products with interchangeable parts were manufactured, and corporate standards emerged that were useable, although clumsy and complicated.

There was very little enthusiasm anywhere to make drastic changes in our engineering procedures. The arguments for the use of English-based units in the United States bordered on the legendary, and all of us have heard the arguments many times over.

The resistance of engineers to change from metric-based units to English-based units in non-North American organizations were just as strong, and although the resulting interchange agreements did allow some cross-pollination of activities, it was a costly, complex system subject to numerous errors in the conversion process alone, not the least of which was the question of tolerances, standard fasteners and the desire of every engineer to demand a full set of field tests, even though a product may have had no major change other than the conversion of fasteners from one basic system to the other.

In the early '70s, many of us in engineering began to look more carefully at what was needed to simplify and enhance our engineering information system. With computer-aided design just around the corner, it became more and more clear that some common system of measurement, no matter what that system might be, was necessary if we were to move ahead rapidly on development of new products and the rationalization of product designs and to enhance customer satisfaction in countries born and raised in the metric environment.

On the basis of this rationale, corporate policy was adopted which stated that Deere was committed to a common system of measurement throughout our company operations and this system would be metric where its adoption could be put in place without significant cost penalty. The net result of this policy was that a higher percentage of new products would be executed within the metric framework, but that few if any old products would be converted to either metric dimensions or metric fasteners. Many of us felt that as old products were phased out, a more common measurement system would emerge and engineering communications with various units throughout the world would be enhanced.

Adoption of a gradual long-term policy to achieve commonality in design executions through the adoption of the metric system deserves a fair share of the credit for enhancing communications but was not alone in this position. Concurrent with the adoption of a common measurement standard was the development of a technical dictionary in four languages which became part of our Deere & Company international standards. This dictionary has grown from relatively simple beginnings to a four-volume set of multi-language, metric-based technical explanations which are used as notes or appendages to drawings and product specifications created anywhere in the Deere system, whether it be by conventional technique or increasingly computer-aided design capability.

It is an interesting side note that the almost simultaneous introduction of computer-aided design capability atabout the time the metric issue reached its apogee probably slowed down the universal adoption of the common metric system more than it helped. The programming change for producing design output in either metric or English units is relatively simple, and as a result the agony of major disruption by universal change was delayed.

All of us are familiar with and have read about some of the savings and some of the activities in Deere which resulted in many cases in somewhat lower product and manufacturing costs with the adoption of metric standards. The selection of sheet steel to nominal metric dimensions even though thesheets may have started out in life in inch units, was an interesting and novel approach to the introduction of metric dimensioning.

A dramatic reduction in the number of standard fasteners resulted when preferred metric fastener dimensions were adopted in lieu of the almost infinite number of English-based units which had been traditionally used. I would like to announce that the fastener story had a wonderfully happy ending, but although I have been away from active participation now for over two years, my feeling is that we probably did not exercise enough discipline in the fastener policy as we should have. Engineers love to create special designs, whether they are fasteners, other elements or components. Others in this audience can probably attest to the fact that creating special metric fasteners provides just as much reward to a designer as creating a special English-based fastener, but if the fastener issue is to be laid to rest, our design philosophy must be reappraised as well as our policy for the use of standard fasteners.

For several decades now I have been a spokesman for the adoption of worldwide standards and the use of a common dimensioning system. To the disappointment of many of you, I must report that given total freedom of choice, I have no particular interest in the metric system, the English-based system or any system no matter what its origin or its nomenclature. The important issue is to develop a common system worldwide for the free exchange of scientific, engineering, technical and manufacturing data.

Many of you have probably had the experience of living and working in a multi-national environment outside ofthe United States. Western Europe is a good example of this environment. The countries of Western Europe are about the size of our larger States in the United States, but each has its own language, each has its own currency, each has its own set of laws and customs. A single day's business trip might take you from France into Germany to Switzerland and Italy. You would deal with four different currencies, and at least three languages. Astute businessmen learn quickly how to operate in this environment, but it adds an element of complexity and can be a source of error in business and technical relationships.

Compare this environment with the environment in the United States where we can travel in 50 separate States in half a hemisphere and at all times work in a common monetary system and a common language. It probably will be disputed by historians, but I believe that adopting a common system of technical and business exchange within the States of our country played no small part in propelling our United States to a position and stature, if not dominance, in world trade. For these and other reasons, it behooves those of us in industry in the United States to adopt a common standard of measurement to facilitate the exchange of technical information worldwide.

None of us any longer have freedom of choice of what this measurement system will be. It is worldwide, the S.I. system of measurement or more commonly the metric system. Adoption of the metric system for the manufacture of products in the United States for use in other parts of the world greatly simplifies all the processes associated with developing markets for United States manufactured goods on the emerging global markets.

In order to accomplish what I believe is absolutely essential to our nation, we must be extremely careful to not become cause-oriented or argue for measurement benefits that are only incremental to the adoption of the metric system. Amongst ourselves and when we talk to others, we tend to argue that the metric system has some inherent simplicity because it is a decimal system and because the constants used in the development of engineering specifications are in some special way fundamental to the process of measurement.

In my judgment we should avoid this thrust. A friend of mine, a pastor in a local church, told me one time that if God had intended the world to be on the metric system, Jesus would have had 10 disciples. This may have beem said in jest, but it is the tip of the iceberg with regard to the thought process involving universal adoption of metric dimensioning.

We must be extremely careful to make sure that the metric system is used where it benefits industry. As a common system of measurement the metric system offers enormous advantages in the development of technical information worldwide with a minimum of conversion errors and a maximum of readability and understanding. For this purpose it is ideally suited to our technical world and I strongly advocate its adoption and use for this purpose.

The connotation in this effort that must be avoided and which has raised the resistance on the part of the general population in the United States derives from an "either/or" mentality. When the metric system was first proposed as a standard for use in the United States, there were outcries throughout our country that there was no need for change, that it would be enormously expensive and that we would have to change all our thinking and buying habits. These fears were based on the fact that teaspoons would become grams, quarts would become liters, yards would become meters and a whole raft of changes would affect our domestic life.

The truth of the matter is that I advocate none of this and see no reason why we cannot adopt the metric system where it serves a useful role in trade and commerce and continue to use the conventional English-based systems where it serves our domestic life.

Those of you who fly know that we live in the United States on a giant sheet of graph paper. In the developing years surveying parties traveled throughout the land and laid down section lines in one mile square grids. If you fly in a light airplane over some of the most remote parts of our Western States, section lines will appear in the desert, on the sides and tops of mountains and in almost inaccessible valleys. I sometimes ponder over how they actually got there, and yet there they are. It would be foolhardy and of no productive reward to suddenly decide that section lines would be in kilometers rather than English miles. A section is a section, and it makes no difference to our relationship as an industrial nation to global markets whether the sections are measured in miles, kilometers, chains, rods, or whatever you choose.

The same can be said for much of our domestic activity. Those of you who have lived and worked in Europe know that even in all metric countries you still purchase food by the pound, which is 500 grams, slightly larger than our United States pound, but for practical purposes the nutritional equivalent. Bottles of milk or wine look about the same, and it is really unimportant whether it is a liter or a quart or some other unit of measurement, it is in fact a bottle of milk.

The issue of standardization, however, in the more technical world has a critical and powerful influence in what we do as a nation. Has it ever occurred to many of you why airplanes can fly confidently and safely throughout our global airspace, including the Soviet Union and its satellites. Interestingly enough, standardization of air traffic and meteorological observation, although not total, is remarkably consistent. Throughout the world the frequency of 121.5 MH, or its multiple 242 MH, is the international distress frequency. AM modulation was adopted for voice communications between 118 MH and 136 MH. FM modulation was adopted for navigation purposes in the VOR or visual omni-range system between 108 MH and 118 MH worldwide. The instrument landing systems throughout the world are FM modulated between 108 MH and 112 MH. The treaty which established this worldwide example of standardization was written in 1933, not long after Lindbergh's flight from New York to Paris.

The point I make is that the role of the metric system in the world is to facilitate the simple, clear and error-free transfer of scientific, technical and engineering data between consenting participants and to minimize the complexity that derives from the use of competing systems or those designed intentionally to obfuscate.

With some acceptance of the mission of the metric system in our industrial world the real question we face is how to implement that mission within the United States and in concert with other metric-based countries. To start with, we should make sure that we properly portray the metric system in our country not as an end-all system for all classes of measurement, but a fully compatible system to be used in the interest of improved technical and business relationships, particularly as these relationships apply to products of increasingly more complex technology.

It may come as a surprise that a great many products in the United States have been metric almost their entire life. The most common of these is the 35 MM camera which had its origin in pre-World War II Germany. We go from there to pharmaceuticals and prescription drugs which have been dispensed since their inception in grams or cc's. What is probably less known is that virtually all visual light optics are specified in metric dimensions. Anyone involved with photography is appreciative of the almost universal 50MM lens and its shorter or longer 28MM and 90 MM cousins. In the manufacture of transmissions we have virtually standardized on the preferred millimeter dimensions for ball and roller bearings, and in engine manufacture a product which is built in the highest volume of practically anything in the United States, the common spark plug, is an all metric product with 10 MM, 14 MM and 18 MM standards.

In the heavy equipment industry the injection equipment for diesel engines is all metric with plunger size, injection line dimensions and injector nozzles specified in metric dimensions.

The list goes on and on and is a result of business decisions made in some cases decades ago that quite simply stated in a very pragmatic way metric specifications for the products involved was the best economic decision.

The question we face now is how to use the lessons learned from history to enhance the productivity of our industrial base in the United States. I suggest that we continue to use the metric system in the design of new products where the application of preferred metric dimensions will increase marketability, lower cost and enhance the business interface between the United States and the emerging global markets.

Secondly, and probably of greater importance than any single effort is to work within our professional societies to develop industrial standards which are consistent and interchangeable with standards developed by the ISO for the nations of Europe and other organizations which develop and distribute standards in other parts of the world. The ridiculous waste of man and brain power in the development of competing standards which vary only in their employment of different measurement bases is not only wasteful but in my judgment intellectually deceptive. I cannot accept, for example, why standards for roll protection in the heavy equipment industry written in the ISO format of the EEC countries is not a perfectly acceptable standard in our United States down to the last comma and period. I see no reason why engineering talent should be wasted converting metric standards to English units or English units to metric units under the guise of producing a standard more applicable to a specific local area. It is beyond my comprehension how a crawler tractor in North America demands one set of roll guards and those in Europe a separate set with different levels of protection, simply because they are dimensioned in different systems. Is a human life in one part of the world worth more or less than that same life in a different part of the world.

I am not so naive as to think that standards, whether they are metric or English, are not used from time to time as non-tariff barriers and as an impediment to the cross-flow of products between competing countries; because they are. I remember during the time I lived in Europe the headlight issue between France and West Germany. For automobiles to be sold in France an amber tinted lens on the main driving lights was required. In West Germany amber tinted lenses were prohibited, and yet the countries shared a common border, had about the same weather, and at that time at least, the same driving regulations. We should not let metric system adoption be manipulated to serve the self-interests of organizations involved in the development of standards or the manipulation of international trade.

The practical question we face is how to enhance the continued use of preferred metric units in the development of products and the writing of standards in our United States. Although I am no longer active norinvolved in the introduction of new engineers to industry, I was continually surprised during my corporate years with the number of engineers who came to industry with virtually no knowledge of not only the metric system but the role that measurement and standards played in international trade. It might be possible to insist through the process of accreditation that engineering schools make sure their graduates leave the campus with some knowledge of metric system utilization and are conversant with its application. Obviously, this cannot be applied universally, as some engineering disciplines are predominantly English unit based and will remain so

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for the foreseeable future. Civil engineering and the construction trades which tend to be more local in nature come to mind as an example. I would expect that common sense and judgment can and will be exercised by our educators, so that we provide our engineering graduates the tools they need to be involved in the broad global aspect of the business world which is becoming increasingly more technical and increasingly more metric.

I don't plan to give you a laundry list of things to do to promote and enhance the technical environment in which we live and work with the use of the metric system. Most of you are far more familiar, far more current with these activities than I am. I would like to leave you though with a relatively simple premise that says in effect that if we as a nation intend to regain our competitive edge in world trade, we must minimize the technical restriction to the exchange of information, eliminate non-tariff barriers to the distribution of products and develop universal standards which are applicable throughout the technical world in which we live and work. To this end, adoption of the metric system for industry and technology in the United States not only is by far the best vehicle available for our use, it is, in fact, in my judgment, the only vehicle.

Gordon H. Millar

GHM/vmm

Mr. **Walgren** [presiding]. Thank you very much, Dr. Millar. You actually print 500 and 400 are left over?

Dr. **Millar**. Oh, I think, you know, that's off the top of my head. I'll go back and find out that because in the intervening time, why they very rapidly were used, but it's not a report that was in high demand, let me put it that way. The greatest use of it was right here with this committee, and I think that's probably as it should be. Although, we did distribute some to others, I don't want you to hang me on that there's 400 left. There may not be.

Mr. **Walgren**. I take that to magnify the responsibility of this committee, inasmuch as apparently we are the ones that have the benefit of that information, and that's very valuable information. Somehow or another, we're going to have to be the ones to translate it into something valuable and concrete.

Dr. **Millar**. Well, the 1986 report is included in part of my testimony, and there should be 75 copies here, so you have that report and I know you have the 1984 report. In 1985, for some reason, I could not testify, and I don't know whether that report was distributed at that time or not. But, it really is in two parts. One, is the first part, which we titled the chairman's overview, which I authored, and which is the first five or six pages. Then, there are reports of the individual centers, and then there are some backup reports which chronicle the performance of the centers at the National Engineering Laboratory.

The other laboratories in the Bureau have the same kind of reports available. The National Engineering Laboratory, however, focuses—takes probably 60 percent of the NBS budget to my recollection.

Mr. **Walgren**. Well, thank you very much.

Let's turn to Ms. Davis. Welcome to the committee.

STATEMENT OF HELEN DAVIS, WASHINGTON REPRESENTATIVE, AMERICAN SOCIETY OF TESTING AND MATERIALS, WASHINGTON, DC

Ms. **Davis**. Good morning, Mr. Chairman and members of the subcommittee. It's really an honor to sit between these two very distinguished gentlemen, both of whom are well known to our standards community. If that weren't awesome enough, this is the first time I've ever done this, so I need to tell you that I'm going to read my statement.

Mr. **Walgren**. We welcome you.

Ms. **Davis**. Thank you.

And, I am to bring you greetings from Pennsylvania, on behalf of Mr. O'Grady.

My name is Helen Davis and I am the General Manager of the Washington Office of ASTM. I'm here today to deliver a statement for Mr. Joseph G. O'Grady, the president of ASTM, who regrets that he can't be here himself.

ASTM has appeared before this subcommittee or submitted testimony for the record for the past several years, whenever the National Bureau of Standards has presented its budget request. The history of ASTM is known to this subcommittee and is part of the record, so I will not use the time allocated for us today to repeat it.

I should like to point out, however, that ASTM, formerly known as the American Society for Testing and Materials, is the leading standards organization in the world for the development of voluntary consensus standards for materials, products, systems and services.

Although we're in complete accordance with the goals of the bills written by Senator Hollings and Congressman Ritter to further U.S. technological leadership, we are a nonprofit corporation and as such cannot take a position on national policy issues, nor can we seek to influence the arrangement of governmental responsibilities.

Our comments today will be restricted, therefore, to our relationship with the National Bureau of Standards and the need to keep it vital and strong.

The work of the National Bureau of Standards creates basic substructures upon which this Nation's standards are built. ASTM produces nearly 8,000 standards; more, we believe, than any other organization in the world. The integrity of these documents is recognized in every corner of the globe. This would not be so without the participation and cooperation of the almost 300 scientists and engineers of the Bureau in the work of the technical committees. This could not be so without the basic research, reference materials and advanced measurement techniques developed by the Bureau. We cannot stress enough the importance of this relationship.

The work of our technical committees covers a wide spectrum of subjects that includes ferrous and nonferrous metals, ceramics, plastics, industrial chemicals, construction materials, petroleum, textiles, sports equipment and consumer products. It is clear that U.S. industrial competitiveness is related to materials and products such as these that are optimized by standards of quality and performance.

Our industrial competitiveness may also be linked to the kind of cooperation that exists between the National Bureau of Standards and the voluntary standards system.

For example, it was the leadership provided by scientists at the Bureau, as well as those from the industry that resulted in the formation of ASTM's committee on biotechnology. This committee's work, although just beginning, could give this country its first national consensus standards in biotechnology, an emerging and important new American industry. There are too many examples of this kind of cooperation to mention here. We are using the biotechnology project to illustrate only one of the contributions of this national laboratory and its scientists to the voluntary consensus standards system, and because this industry has been mentioned specifically as an area critical to U.S. competitiveness.

Because both the bills of Senator Hollings and Congressman Ritter recognize the importance of the potential contributions of the Bureau to small businesses, it might be appropriate here to mention that ASTM has long realized the importance of the contributions small businesses make to innovation, the development of new products, and to the overall competitiveness of U.S. industry. We encourage and support participation within our own system and we applaud any effort to strengthen their capacities.

In conclusion, while we cannot promote any specific areas for support, and while we cannot participate in the actual business of restructuring the agencies of the Government or their appropriations, we can state our belief that the research arm of the Government must be supported by the Congress to achieve an invigorated U.S. industry that is competitive in the world's markets. It is our belief that every program within the Bureau is vital, and that the work of the Bureau is one of this country's greatest assets.

Thank you.

[The prepared statement of Joseph G. O'Grady, delivered by Helen Davis follows:]

STATEMENT OF JOSEPH G. O'GRADY

PRESIDENT OF ASTM

ON THE
ROLE OF THE NATIONAL BUREAU OF STANDARDS
IN COMPETITIVENESS

SUBMITTED TO THE
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

OF THE

UNITED STATES HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

APRIL 28, 1987

Good morning Mr. Chairman and Members of the Subcommittee. My name is Helen Davis and I am the General Manager of the Washington Office of ASTM. I am here today to deliver a statement for Mr. Joseph G. O'Grady, the President of ASTM, who regrets that he cannot be here himself.

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The work of the National Bureau of Standards creates basic substructures upon which this nation's standards are built. ASTM produces nearly 8,000 standards; more, we believe, than any other organization in the world. The integrity of thse documents is recognized in every corner of the globe. This would not be so without the participation and cooperation of the almost 300 scientists and engineers of the Bureau in the work of the technical committees. This could not be so without the basic research, reference materials and advanced measurement techniques developed by the Bureau.

WE CANNOT STRESS ENOUGH THE IMPORTANCE OF THIS RELATIONSHIP.

THE WORK OF OUR TECHNICAL COMMITTEES COVERS A WIDE SPECTRUM OF SUBJECTS THAT INCLUDES FERROUS AND NON-FERROUS METALS, CERAMICS, PLASTICS, INDUSTRIAL CHEMICALS, CONSTRUCTION MATERIALS, PETROLEUM, TEXTILES, SPORTS EQUIPMENT AND CONSUMER PRODUCTS. IT IS CLEAR THAT U.S. INDUSTRIAL COMPETITIVENESS IS RELATED TO MATERIALS AND PRODUCTS SUCH AS THESE THAT ARE OPTIMIZED BY STANDARDS OF QUALITY AND PERFORMANCE.

OUR INDUSTRIAL COMPETITIVENESS MAY ALSO BE LINKED TO THE KIND OF COOPERATION THAT EXISTS BETWEEN THE NATIONAL BUREAU OF STANDARDS AND THE VOLUNTARY STANDARDS SYSTEM.

FOR EXAMPLE, IT WAS THE LEADERSHIP PROVIDED BY SCIENTISTS AT THE BUREAU, AS WELL AS THOSE FROM THE INDUSTRY, THAT RESULTED IN THE FORMATION OF ASTM'S COMMITTEE ON BIOTECHNOLOGY. THIS COMMITTEE'S WORK, ALTHOUGH JUST BEGINNING, COULD GIVE THIS COUNTRY ITS FIRST NATIONAL CONSENSUS STANDARDS IN BIOTECHNOLOGY, AN EMERGING AND IMPORTANT NEW AMERICAN INDUSTRY. THERE ARE TOO MANY EXAMPLES OF THIS KIND OF COOPERATION TO MENTION HERE. WE ARE USING THE BIOTECHNOLOGY PROJECT TO ILLUSTRATE ONLY ONE OF THE CONTRIBUTIONS OF THIS NATIONAL LABORATORY AND ITS SCIENTISTS TO THE VOLUNTARY CONSENSUS STANDARDS SYSTEM, AND BECAUSE THIS INDUSTRY HAS BEEN MENTIONED SPECIFICALLY AS AN AREA CRITICAL TO U.S. COMPETITIVENESS.

BECAUSE BOTH THE BILLS OF SENATOR HOLLINGS AND CONGRESSMAN RITTER RECOGNIZE THE IMPORTANCE OF THE POTENTIAL CONTRIBUTIONS OF THE BUREAU TO SMALL BUSINESSES, IT MIGHT BE APPROPRIATE HERE TO MENTION THAT ASTM HAS LONG REALIZED THE IMPORTANCE OF THE CONTRIBUTIONS SMALL BUSINESSES MAKE TO INNOVATION, THE DEVELOPMENT OF NEW PRODUCTS, AND TO THE OVERALL COMPETITIVENESS OF U.S. INDUSTRY. WE ENCOURAGE AND SUPPORT PARTICIPATION WITHIN OUR OWN SYSTEM, AND WE APPLAUD ANY EFFORT TO STRENGTHEN THEIR CAPACITIES.

IN CONCLUSION, MR. CHAIRMAN, WHILE WE CANNOT PROMOTE ANY SPECIFIC AREAS FOR SUPPORT, AND WHILE WE CANNOT PARTICIPATE IN THE ACTUAL BUSINESS OF RESTRUCTURING THE AGENCIES OF THE GOVERNMENT OR THEIR APPROPRIATIONS, WE CAN STATE OUR BELIEF THAT THE RESEARCH ARM OF THE GOVERNMENT MUST BE SUPPORTED BY THE CONGRESS TO ACHIEVE AN INVIGORATED U.S. INDUSTRY THAT IS COMPETITIVE IN THE WORLD'S MARKETS. IT IS OUR BELIEF THAT EVERY PROGRAM WITHIN THE BUREAU IS VITAL, AND THAT THE WORK OF THE BUREAU IS ONE OF THIS COUNTRY'S GREATEST ASSETS.

THANK YOU.

Washington Office

Helen J. Davis is the General Manager of ASTM's Washington, D.C. Office.

In this capacity, she represents ASTM in Washington, D.C. through interaction with government agencies, Members of Congress and their staffs, and representatives of foreign governments.

Before becoming ASTM's Washington Representative in 1979, Davis served the voluntary standards community as a Research Associate for both John C. Green Associates and Richard O. Simpson Associates, ASTM's Washington Consultants.

A native of Philadelphia, Davis has attended Temple University, the University of Maryland, and the University of the District of Columbia.

ASTM is a management system for the development of voluntary consensus standards for materials, products, systems and services. Currently, ASTM has 30,000 members from around the world representing industry, governments, academia and consumers. Participation in ASTM is open to any interested party. The Annual Book of ASTM Standards contains over 7,000 test methods, specifications, practices, guides, and definitions developed by ASTM standards writing committees.

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Mr. Walgren. Thank you very much, Ms. Davis.

Let me ask, and I apologize for having been out of the room earlier, but could I get comments on the degree of penetration of this automated manufacturing test bed? What are people taking away from it when they leave? What's the limitation on its pickup? As I understand it, many people who are exposed to it are then just not pursuing the directions that it implies intensely. Can you give us any guide on how that facility is being received?

Dr. Millar. That, of course, is a very perceptive question, and I'm not so sure that I can give you a quantitative answer in the sense that how is the laboratory itself, the physical facility, being used by industry. I don't really think that's been its important contribution. A real contribution that the AMRF made, was as a demonstration facility for the use of computer integrated manufacturing, to be able to go from a design mode, a terminal that you design on a CRT, directly to the machine part without any intervening human effort.

What industry got out of that—we had a conference last August that invited a number of industrial people to Gaithersburg to view the facility—was the confidence to make their own investments back in their home plants. They had never seen anything like this work. And, those of you who have been involved in the industrial world know, that for reasons that all of us understand, we are becoming a nation willing to take less and less risks. We tend to want to know answers before we really make investments. And, we do that more and more in business simply for a couple of reasons. One, we're a more mature nation now than we were as every day goes on, and secondly, we have some tools to make judgmental decisions that are sharper, and cleaner and finer than they have been in the past. So, we try to reduce risk in the manufacturing sector.

As an executive of a manufacturing company, to come to the Bureau and actually see this kind of operation put together and see that it can really work, and the fact that you can develop standards of manufacturing, standards of software protocols and things of that general nature, gives our industry a certain amount of confidence that as they use those results in building your own plants, that they have reduced some of the risk. So, in my judgement it's done very well in that area.

Mr. Walgren. Let me add one other aspect to the question, and then give you all a chance to add if there's anything further that could be added. That is, how does it compare with this activity in the Navy called RAMP, rapid automated manufacture of parts, or something to that effect, where as I understand it, they also have a similar effort which is designed to literally transfer this kind of technology to their suppliers, supposedly to put the Navy in a position of having access to individualized, discrete manufacturing totally automated processes. Is there any comparison we can make to the NBS effort, and I'd like to ask that again and then hear from the others.

Dr. Millar. My understanding of RAMP, and I've just been exposed to it recently, is that it, in fact, uses some of the basic technology laid down by the AMRF in the design of the RAMP process. And, so, what the Bureau contributed to creating AMRF in whole or in part, now blossoms as an active application in RAMP. That's my understanding of it.

Mr. **Walgren**. Can I ask for other reactions?

Dr. **Branscomb**. Yes. Mr. Walgren, I think there is similarity in the sense that in both cases the effort is really devoted to trying to solve some of the tough, technical challenges that may impede the best use of these technologies by reasonably committed users. I think the Navy case, the Navy had a problem that it had a production requirement that couldn't be satisfied by the conventional capabilities of their normal suppliers, and the Navy had to make an investment in technology in order to do that. Of course, in the course of it, the transfer of that technology is very natural because the Navy is in a procurement position. And, it would be very appropriate indeed if in that work the Navy was able to draw to some extent on NBS capabilities or contribute to them.

I'd like to come at the question, if I could, from the other end. Rather than asking in what way does the NBS capability get transferred into this little company. I'd like to refer you to a piece of work done by Professor Skinner at the Harvard Business School—I don't have the reference with me, but I could get it—who made an analysis of why it is that there is not more extensive use of modern manufacturing systems by American middle size companies. And, he gave several reasons. One of them is that in the normal way we do accounting in our businesses, if you want to make a big capital investment in the plan, somebody's going to calculate the return on investment and that's how the decision will be made whether to do it. That return on investment will be made on the basis of the products that are first going to be built in this modern factory. So, you have the expense of all the capital equipment, of the tedious and difficult problem of bringing the thing up and bringing the bugs out of it and getting its yield high, its production levels high. All those costs get laid into the first set of products that it makes, and it's very unlikely, as he points out, that any factory modernization process will in fact look like a good investment when you lay all its costs on the first bunch of products.

The reason the people do it that do it, is because if they don't they're in a strategically totally vulnerable position for the next round of products after that and the one after that. In other words, it requires a strategic investment mentality by the company to go down this difficult road, and not enough of our companies are taking that point of view. And, I don't think the Bureau of Standards can change their minds, but maybe somehow the rest of our society can help.

Secondly, Professor Skinner says that part of the problem is an inadequate number of inadequately capable and well-financed consulting firms prepared to offer turn-key services to a small manufacturer, who say, hire me. I don't make the equipment, but I'll help you buy it and I'll help you install it, in fact, I'll even get it up and running and train your people on how to do it. That approach will substantially reduce the manufacturer's risk. It will still be substantial, but it will reduce it from what it would be if the manufacturer has to learn all this technology in the course of spending his money and trying to do this job for the first time. Therefore, I think it's very important that the Government agencies that have a deep technical capability put themselves in a position where, to the extent possible, they can help both the manufacturers of the tooling, the robots, the control systems and the like, but they could also help the vendors who are in the job of trying to help customers justify and design and install these systems. That's one reason why I have a suspicion why an imaginative State government might well be able to put a consortium together of both users, vendors and consulting enterprises to provide the kind of demonstration facility and support to these turn-key companies, that the Bureau could then contribute to.

Finally, I think it's very important that we realize that one of the base problems, and here the Science Foundation has a big contribution to make and so does the Bureau. The basic problem is that our engineering schools communicate to the students that this production technology is not the prestige end of the practice of engineering. And, we do not get the best people in the factory end of the business. That's a serious, serious problem because the Japanese do get the best people in that part of the business. So, to some extent we've got to find a way to give this whole area of technical activity more visibility or prestige and more scientific clout. That's why I'm for getting the Bureau of Standards out from under its blanket where the world can see it.

Mr. Walgren. What is the best part of the business in the engineering?

Dr. Branscomb. Oh, by far and away it's research and development. Every young engineer wants to be in research and development. In fact, most Government reports about technological policy leave you the impression that that's all there is. You'd be amazed how often Government reports refer to R&D as though that were a surrogate for the technological enterprise. Mr. Millar knows better than I that it's not so.

Dr. Millar. Except that Dr. Branscomb doesn't speak for all of us. I enjoy manufacturing. I enjoy designing products, and I think design is the name of the game as far as engineering is concerned, and the research people give us the raw material in which to create a product, because engineering is the profession of the humanities. We intend to take science and apply it for the good of mankind, and so, that whole aspect, as far as I'm concerned, is, you know, the heart of engineering. But, everybody has their own view.

Dr. Branscomb. Please don't misunderstand me. That was not my position. I thought I was trying to describe what I believe is the prestige situation in American engineering schools, and if you disagree with me, I'll be very encouraged.

Dr. Millar. I think you're right about the schools.

Mr. Walgren. We'll clear this up later.

Ms. Davis, would you like to respond and then I want to move to other members?

Ms. Davis. Well, only that this sort of give and take is exactly what goes on in the standards setting system, which is how we achieve our wonderful consensus documents.

We do not have a present activity in computer aided design or computer aided manufacturing, but we certainly are thinking very hard about it. Part of the way a standards activity comes about is usually incentive from the marketplace or the industries involved.

When that happens, then that is when our standardization process works, but we're thinking hard about it.

Mr. **Walgren**. Thank you.

Mr. Boehlert?

Mr. **Boehlert**. Mr. Chairman, I would suggest that we allocate our time to Doctors Millar and Branscomb to continue their spirited discussion. It would be the best show in town.

I tell you, both of you have made me feel a little more comfortable in terms of the government reaction to the situation in the international community in terms of dealing with the issue of competitiveness. People like to point to Washington and say everybody fails in Washington, that's why the country is going to hell in a hand basket. What I'm hearing from you is, and I believe it's true, is that there's a lot of room for improvement in the private sector. And, as Dr. Branscomb, you point out, they don't have the strategic investment mentality, they don't put their best people, they don't make it attractive enough to go into manufacturing. They fail at so many other areas, but they're not reluctant to pay CEO's like Lee Iaccoca $20 million and say, we've solved the problem.

One of the things that concerns me is technology transfer, particularly to small business. And, I'm toying with the idea of—I'm in the process right now of developing legislation that would create a sort of an extension service for technology, much like we have in the extension service nationally to tell people how to plant gardens. I want people to continue to plant gardens, but I'm more anxious to help small businesses become more competitive, and that's why I'm toying with this idea. I'd like to have all three of the panelists, if you will, address the question of how do we improve technology transfer and particularly to small business?

Dr. Branscomb?

Dr. **Branscomb**. Well, you might start by going back and reviewing the State Technical Services Act, which I believe has never been taken off the books, although it has never been funded. I'm not sure that's the right mechanism, but it's interesting. There is a statute for it back in the late 1960's, there was also a lot of interest in this subject. It's a starting point.

Secondly, my own view is that the NSF is doing the right thing with their engineering research centers, and I think they will also do the right thing with the science and technology centers. The manufacturing oriented centers that are contemplated for the Bureau of Standards in the proposed legislation could also be done in that kind of environment. That is, I could imagine such centers being established, not always, but often at a good engineering school in the community in collaboration with that institution, with the support from local industry, active participation from the State, some form of technical support operation within the State structure but aimed, not at hiring experts to tell manufacturers what to do, but aimed at trying to ensure that there's a healthy engineering consulting enterprise that small companies know what are their choices on where they can go to get technical help. And, where the backup for that technical help is within the Government's R&D structure. For there is a great deal of talent out there that we don't make it easy for people to get at.

Secondly, and I believe with this notion, I think the committee ought to watch very closely what the administration does with the October 20th, last amendments to the Stevenson-Wydler Act, the Technology Transfer Act of 1986. That piece of legislation, in my opinion, cured most of the ills which I had previously ascribed to the old Stevenson-Wydler Act, and adds some very interesting new incentives for government laboratories to work with private sector in the States. And, maybe you can leverage that existing statute. I believe the administration has just issued an Executive order. I think it's 11030, which is the first step at least in the administration's implementation of it.

Mr. Boehlert. Thank you.

Ms. Davis?

Ms. Davis. Well, I can only speak about the technology transfer that takes place in a technical committee, such as the ones we have. In an activity where the result will be the commercialization of a product, we require the balance of a technical committee. In that producer segment we see to it that small business has equal influence, equal vote, which means that their influence goes one way out to the committee. But, the technology transfer that takes place is, their actual participation on a committee where the benefits of the larger businesses and other research efforts come back to them for free. They sit there and they associate with their colleagues and take it home with them.

We also do other things besides produce standards, and that is the second part of our charter, which is the dissemination of related knowledge. We encourage symposiums that give state of the art papers and the like. We encourage our small businesses to always be there. As a matter of fact, we help them financially if they can't, and in other ways encourage them to be there.

Mr. Boehlert. Dr. Millar?

Dr. Millar. If I can put my small business hat on for a minute. I have to share with you that small businesses usually aren't small because they want to be. They tend to be small because the area in which they operate, and the struggle to expand has so many negative factors associated with it, that lots of time you're very happy to just have a business at all. And, in the manufacturing sector that becomes particularly important as high tech manufacturing races ahead, and the major companies can make the major investment and the small businessman finds those very difficult. We become so productive in some of the machines that we create that the small businessman—if I bought one of those machines, in one week I could run my entire production that historically I had to do in a year. So, the problem isn't quite as simple as just making the technology available to the small businessman. There are some things that can be done, but you have to be a small businessman before you realize what some of the problems are.

Today we're struggling. This little company I'm involved with, in introducing a Cad-Cam system. We'd like very much to put in some computer capability so that we can design our parts without the necessity of going through the long tortuous process of making a traditional engineering drawing. And, you end up finding out that the purveyors of those parts, the vendors of the various systems have fine systems that will design F-16's or one thing of that nature, but for our simple little parts, some of that technology, some of the componentry is just simply not available.

I think an information center, that we could go to and say, all right, we have a limited scope of manufacturing activity, has anybody made any studies to know that if we had an expanded PC computer and some kind of a drafting device or whatever. Here's a collection, here's a sequence of activities in the manufacturing for a business about your size. You wouldn't have to provide us any money. You wouldn't have to provide any of the physical machines. What we would really need is an information source for someone who has no proprietary interest in selling any particular element of what you might recommend, would give us a clear, unbiased view of how we could take some of this information and put it to work for us within the environment of a small business. I think that stands a chance of being successful.

Mr. **Boehlert**. I take it you would like my technology extension service concept?

Dr. **Millar**. Yes. Well, you know, I haven't read about it, but I did serve on a committee for the Manufacturing Studies Board where we examined that whole process a couple of years ago, and came up pretty much with the idea, or at least as I recall the report, that something like the old Agricultural Extension Service, which really did essentially that. You know, we kind of pass that off as being history, but we still are a very powerful nation as far as agriculture is concerned. Nobody can get the yields that we can get, or have the productivity in agriculture, if you want. You know, you can argue about erosion and you know, contaminating the rivers, which all will be solved in time. But, we're still an extremely productive nation, mostly because, and people tend to forget, the extension service taught the farmers how to grow.

All right. Now, as a small businessman, maybe you can take some of this information and strip away, if you will, the salesman approach. In other words, for all the different computer companies or the machine tool builders, or one thing or another, and let us have a peak, if you will, at what makes a good system and what's cost effective for the size of business we do. Now, you can't do that automatically, because it's going to take some study, just putting up the sign, and saying, you know, we now have a center of manufacturing excellence, whatever you want to call it. That isn't going to quite do the job. You have to support it with people that know what they're doing and you have to support it with people that understand the business world, and you have to support it with some of the engineers that we're going to get from the new breed of engineers that will be involved in that whole process. It's not an overnight project, but I think it has some merit.

Mr. **Boehlert**. Thank you very much.

Mr. **Walgren**. The gentleman from Colorado, Mr. Skaggs?

Mr. **Skaggs**. Thank you, Mr. Chairman.

Dr. Branscomb, I was curious about one of the comments you made in your testimony about the nonrelationship between NBS and NSF. One, wondering what your suggestions might be of how to effect a—or give me a sense of the history of that, and what positive results you might see coming out of a better relationship between those two organizations given the subject matter of this morning?

Dr. **Branscomb**. Well, there's never been any friction, as far as I know, between the two institutions, but if you go back in years, when I became Director of the Bureau of Standards, the first thing that I appreciated was that the fields of science that were most vital to technology tended to be things like ceramics, polymers, materials science in general, instrumentation, measurement and the like. I was interested in furthering the nation's capability by more than simply the Bureau's in-house work. And, so I asked Bill McElroy, who was Director of NSF, could I come down and talk to his management and just share what I was trying to do at the Bureau of Standards, and see to what extent they thought they either wanted to or didn't want to make a contribution, not by giving us money, but by funding that kind of work themselves in universities. It took me six months to persuade him to allow me to talk to his management. I finally did. We didn't find much of common interest.

That world has completely changed. The National Science Foundation today is the principal instrument of the President's competitiveness strategy and it's a favorite chosen instrument for a lot of us, for some very important functions. Perhaps most important of all, is to provide some of the linkage between industry and the world of R&D, which the universities sit astride in engineering and science in an amazing way.

Now, I worry a little bit about over committing our universities in this current environment, raising expectations that go beyond the capability. But, that's another issue. On this point, we do have a situation now in which the NSF has created an engineering directorate, an identification of the flag science, as though they were the same, it isn't. We have a major commitment from the administration to move in the direction of technology, strengthening that engineering program and the computer work that relates to it, more than the rest of the foundation. And, getting into the encouragement of interdisciplinary work in practical areas of science, in collaboration with industry. That to me provides a real opportunity, and the opportunity for example, is that to the extent there are engineering research centers, the concern with things that relate to manufacturing, funded by the NSF, it seems to me that a working relationship with the Bureau's people in this area could be valuable to those universities, and could also provide another linkage for the Bureau's people to industry. If indeed, in the spirit of the legislation we're looking at, there were funds available and encouragement to the Bureau to do more in the way of what we call in social science, outreach, then I would think the Bureau of Standards might well want to have a more active role as a collaborator in some of those operations. Or, indeed use that style of operation as something that itself does from time to time. But, in the spirit of the Stevenson-Wydler Act, it specifically authorizes it.

Finally, I think we have to appreciate that there was a fair amount of discussion on the Science Board at the time of the proposal of the DITI, which would have created that marriage had it been done. And, let me say the climate was not hostile to the idea of a relationship. At that time NSF had an awful lot on its plate. It wasn't clear they had the management time to sort of take that on as an emergency issue, for an immediate reorganization, but I do believe that given the NSF's current direction of orientation to become more clearly committed as an institution to the economic value of Federal/civil R&D, there ought to be an encouragement for some long-term joint thinking of the two institutions. And, as one thinks about the future of the Bureau of Standards, I think one continues to have to think about whether the Commerce Department really is the home that will most give it the opportunity to make this kind of contribution. I would like to see a Commerce Department devoted to industrial technology issues, among others, and not just the trade, but that has not been the prevailing attitude of most Secretaries of Commerce, with two spectacular exceptions, and two very good Secretaries of Commerce from a technical point of view, Henry Wallace and Herbert Hoover. They didn't exactly see eye to eye politically, but they were both technically very well trained people, and they understood what the department could do.

Mr. **Skaggs**. Mr. Chairman, perhaps as we develop reports on both of those authorizations, some encouragement could be given to both agencies in this respect. I'm interested in pursuing that.

Mr. **Walgren**. Would——

Dr. **Millar**. Could I just add one very short comment?

I serve on the Advisory Board for the Engineering Directorate of the National Science Foundation, and of course, have close association with the Bureau, but more importantly, Dr. John Lyons, who's director of the National Engineering Laboratory in the National Bureau of Standards, is also on that Board, and the fact of the matter is, we had our semiannual meeting yesterday. And, I am here today in lieu of being at the Advisory Board meeting for the Engineering Directorate of NSF. And, so the relationship between the Bureau and at least the Engineering Directorate of NSF, at that particular level does exist. On an operating level, I can't speak to that because the two organizations are really quite different. The NSF does not operate a physical plant, physical laboratory in the sense it manages the grants, whereas NBS is the other side of the coin.

Now, you might toy with the idea that some kind of a combination would be a very powerful technical organization, but I think that requires a lot more thought than just talking about it here.

Mr. **Skaggs**. Thank you, Mr. Chairman.

Mr. **Walgren**. Thank you, Mr. Skaggs.

Mr. Ritter?

Mr. **Ritter**. I want to thank our witnesses for their excellent testimony in response to the questions.

If I might add, Dr. Branscomb and Dr. Millar, if I could have your explicit response to H.R. 2068, our House effort in this area, I would greatly appreciate it and include that as part of the record.

Dr. **Branscomb**. Thank you. I'd like to provide that.

Mr. **Ritter**. Have you had a chance to look at it even cursory?

Dr. **Branscomb**. Yes.

Mr. **Ritter**. As I listen to some of the comments that Dr. Branscomb and Dr. Millar have made, I hear things like the possibility of expanding the NBS budget. I hear things about the possibilities of contracting with some profit and nonprofit private sector activities. I hear, Dr. Branscomb, your just recent comment, more active role for NBS in setting up collaborative activity. Dr. Millar talked about competitiveness as total quality. And, one of the elements in the NBSIC proposal that I have offered and a large number of members of this subcommittee and Full Committee have originally cosponsored, talks about a clearinghouse of best practice information on continuous product improvement and total quality, and this concept. Do you think it's feasible and do you think it's appropriate in this new climate that we face to expand the horizon of NBS by giving it these new functions or expanded functions, if you will, of some things they already do, by making NBSIC, National Bureau of Standards and Industrial Competitiveness? Is that a way to start? Would you think it might of necessity be isolated essentially to the Department of Commerce? Let me get a few views more specifically focused on this legislative effort.

Dr. Branscomb. My fundamental view is that the Bureau of Standards is first and foremost a scientific and engineering institution, which conducts at the moment all of its own work in its own laboratories. I'd like to see it broaden its view from that. I mentioned the notion of supporting outside work within the scope of its mission. In that sense it would look—if you did that it would look more like NIH perhaps, but it would still be a laboratory. It wouldn't be the HSS. So, I think some of the policy work and some of the other activities that might be done to bolster industrial competitiveness by federal agencies are more appropriately done by an office that is not part of a laboratory, but in association with it. And, in that sense——

Mr. Ritter. In that sense, if I just could interject, the division of industrial competitiveness, it is a division of the National Bureau of Standards as we have evolved the idea of National Bureau of Standards and Competitiveness.

Dr. Branscomb. I appreciate that, and I guess part of my problem is, I have some trouble with the proposed language. That is, the use of the word "industrial competitiveness" in the title, for exactly the same reasons Dr. Millar does. Competitiveness is a worthy objective which includes a great many things, including macroeconomic policy, and most certainly including marketing and not just technical activities. So, that to label the Bureau of Standards permanently with a title that suggests that it's going to make a contribution that doesn't lie within its capability to do alone, I think would generate frustration and confusion. I do believe the word "standards" already produces a certain amount of confusion in people's minds, and I'm perhaps less opposed to the idea of a National Institute of Technology. Technology is itself a good bit broader than R&D and manufacturing itself, but is closer. I certainly don't have a problem institutionalizing within the Bureau—well, don't have a problem within the Bureau that is specifically devoted to technical activities that people think have a lot to do with competitiveness. I would just try to give that division a title which is descriptive of what it does, rather than descriptive of the very distant national objective to which it would make a contribution, but couldn't make a decisive contribution.

Dr. **Millar**. For the most part, I think I share that view. Within the Bureau, there's an awful lot of work today that focuses very much on how we design, build and market products which have a technological base. It might be that an area within the Bureau could be devoted to this whole concept of total quality as it applies, as it is employed by our manufacturers, and do so in a way that would produce a series of standards, quality standards, if you will, or a common data base that would allow us a more rapid introduction of technology so that we don't have to go, and if you will, reinvent the wheel each time, and things of that nature.

Mr. **Ritter**. Which is something that we have proposed.

Dr. **Branscomb**. That's right.

Dr. **Millar**. Let me go one step further. I think I do agree with Dr. Branscomb, that using the name "competitiveness" as the generic, broad title of the Bureau probably is okay in the short term, but I think it would be better if we could think of a new name. I have said, and our report has reported for the last 3 years, the mission of the Bureau should be examined. And, in our judgement, should be expanded to embrace some of the new factors in the whole area of commerce that didn't exist when the Bureau was formed.

Now, fortunately the legislation, I think, was written into law in 1901, used very broad language, and that's really what saved the day, so far. But, maybe the time has come to do exactly what you say. The only word that bothers me is the word "competitiveness" as an overall umbrella title.

Mr. **Ritter**. It's talking about something akin to National Bureau of Standards and Technology or something like that.

Dr. **Millar**. I'm afraid I can't help you with a new word, but——

Mr. **Ritter**. But, I guess my point is let's isolate out between substance and title, at some point. Do you find that what we have encompassed in this bill, which is quite modest as a kind of almost first step, and where Hollings is going with his legislation. Do you find that what we have encompassed in this bill, the missions that we have integrated in with NBS and some of the expansion of responsibility, do you find that contribution acceptable?

Dr. **Millar**. I have not read the bill in detail. I've just listened to your discussion. But, from what I have heard, I agree. I support it.

Dr. **Branscomb**. I'm sorry, Mr. Ritter, I didn't—my airplane was an hour late and I didn't hear your remarks and have not actually seen the legislation. I've only seen the two-page summary of your remarks elsewhere. And, so I'm really not—I prefer to reserve judgement.

Mr. **Ritter**. Good. I'd appreciate it if we could get your remarks for the record.

[The material to be supplied follows:]

Prof. Lewis M. Branscomb
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Harvard University
79 J.F. Kennedy Street
Cambridge, MA 02138

The Hon. Don Ritter
Committee on Science, Space and Technology
U.S. House of Representatives
Suite 2321 Rayburn House Office Building
Washington DC 20515

Dear Mr. Ritter,

I have had a chance to read HR. 2068 and your remarks to the Subcommittee at the hearing on April 28.

Let me congratulate you on taking the initiative to create a discussion of the Bureau's role in the competitiveness effort, for the administration and many other groups seem to have overlooked this important and capable laboratory. But I have to confess, I am not attracted by the specifics of your proposal.

My problems with the bill stem mostly from three sources:

Competitiveness is only in part dependent on technology; I don't see how a scientific laboratory can be expected to serve as "the Government's focal point for industrial competitiveness programs".

Industrial competitiveness is governed by many factors of which the most important are (a) economic environment, (b) access to large and active markets, (c) quality of commercial management, (d) attractiveness for the markets of product designs, (e) complementary assets associated with use of the products, and (f) costs and quality - the one item which depends heavily on technology. Thus tax, trade, industrial relations, education, anti-trust, monetary policy all have major influence. So too does the behavior of other governments over which no American institution has control. Even the Commerce department cannot lead in all these areas. Surely the Bureau cannot.

Second, the bill is unclear about how far the Bureau is to go toward development of product and process technologies - which most people with business experience (including me) think is best done by private firms. The Bureau's traditional role: developing better means for measuring and characterizing and testing, and sharing these ideas with users, is very appropriate to the competitiveness challenge. So too is your concept of a "best practise" clearinghouse.

But such general objectives as "...promote the most promising research and development which can be optimized for industrial applications..." are likely to draw NBS beyond its traditional competence and raise serious concerns from the private sector about the Bureau's intent and capability.

Third, I don't understand the concept of Competitiveness Impact Statements, which I take it are to be required of (or by?) the NBSIC before "...major legislative or administrative action...which may affect ....trade and industrial competitiveness..." Surely, NBSIC is not expected to require such Statements from other agencies preparing legislation; that is OMB's job. And I cannot imaging a laboratory like NBS preparing major administrative or legislative actions of its own. In any case, it is unclear what use the statements would have. They would necessarily be theoretical microeconomic analyses, which given the power of those tools would likely by of very limited value.

The idea of a division within the Bureau to carry out these programs seems to imply that the rest of the Bureau is not engaged in helping with competitiveness, whereas in fact they all do. However, I think a small operation (probably smaller than a normal NBS Division) devoted to serious data gathering and studies on the factors that govern the role science and technology do play in competitiveness would be useful and could help the bureau understand better how to set priorities, and how to collaborate with firms.

Finally, I have to confess I don't like the new name: NBSIC. It ties the fate of the nation's system of measurements to the outcome of an economic competition with certain foreign nations. Suppose, the US became very competitive again and enjoyed trade surpluses. Would NBSIC be no longer needed?

I much prefer, if the name is to be changed, the National Institutes of Measurement Science and Technology. This is much more descriptive of what the NBS actual does best. It, or something like it, could stand the test of time.

Sincerely,

Lewis M. Branscomb

April 30, 1987

cc: Hon. Doug Walgren, Chairman
Subcommittee on Science,
Research and Technology

Ms. Carol Pompliano,
Subcommittee staff

Dr. Ernest Ambler, Director
National Bureau of Standards

SOUTHWEST RESEARCH INSTITUTE

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17 May, 1987

The Honorable Doug Walgren, Chairman
Subcommittee on Science, Research and
Technology
Committee on Science, Space and Technology
U. S. House of Representatives
Suite 2321 Rayburn House Office Building
Washington, D.C. 20515

Dear Representative Walgren:

At the end of the Committee session last week, I was asked to draft some written comments with respect to H.R. 2068, a Bill sponsored by you, Mr. Boehlert, Mr. Brown, Mr. Glickman, Mr. Morrison and Mr. Ritter. The following comments reflect my reaction to reading H.R. 2068 and are consistent with both my written and verbal testimony at your Committee meeting.

In general, I endorse and support H.R. 2068. In my judgment, nothing is more important to the future of our country than an effort on the part of all of us to regain global competitiveness in the international markets. As I have testified before, we have let this competitiveness slip away because of our preoccupation with business manipulation rather than paying attention to the underlying technology and processes and product development, which is so important to manufacturing in an increasing technological world.

I have some concerns with certain specific phrases and some definitive language in H.R. 2068. Please consider, however, that my comments in no way detract from my endorsement of your Bill but are offered simply as enhancements as seen from a manufacturing position in the private sector.

As was discussed at some length during the hearings, few of us are enthusiastic about the use of the word, "competitiveness," in the title of any organization. I have thought about how we might replace the word, "competitiveness," and although others may have a better suggestion, I believe the use of the phrase, "industrial technology," might better convey what we really intend to do. I fully understand that competitiveness embraces more than just technology, but I must remind you and your Commitee that without a sound technological base, manipulation of the remaining business and trade activities can only be short term solutions.

I suggest that the National Bureau of Standards of the Department of Commerce shall"...after the date of enactment of this Act be known as the National Bureau of Standards and Industrial Technology."

In Line 12, Page 3, H.R. 2068 speaks to cooperative efforts between industries, universities and Government laboratories. Within our United States there are a number of institutions and foundations which are extremely active in the development of manufacturing technology essential to regain national industrial competitiveness. These institutions for the most part not-for-profit foundations are not included in any of the three classifications specifically cited in H.R. 2068. For example, a major institution which has made substantial contributions to manufacturing technology is Southwest Research Institute in San Antonio.

I appreciate that your Bill does not specifically exclude independent research organizations as it is silent in this area. I believe your Bill would be considerably strenghtened by adding independent research organizations to the groups cited in Section 3, Paragraph (3), starting on Line 12, on Page 3.

I am not clear on the origin and management of the fund introduced on Page 12. At the present time, the National Bureau of Standards receives about half its income from outside funded projects. The basic funding of the Bureau is in the range of $120,000,000, with an almost dollar-for-dollar funding received from projects which are pursued in the interest of industry. If I interpret the language of Paragraph B, the industrial funds now received by NBS would be deposited in a new fund to be managed by the Director in support of policy structured by a new board. The fund would be supplemented by the additional infusion of funds by appropriation as specified in Section 11.

It is my feeling that the funds currently attracted by the Bureau should not be included in the new fund, as they have become over the years an intrinsic part of the support pattern for NBS, and in my judgment restructuring this funding process would be counterproductive to the continued growth of Bureau activity.

I propose, therefore, that the fund identified in Section 10 be made up of funds attracted to this activity through new effort and supported by the appropriations in Section 11. I would not include in the fund those moneys now paid by industry in support of current NBS industrial activity.

I understand the thinking behind the creation of a new board, but I am unclear in how the new board would function.

At the present time, the Bureau of Standards is managed by a board called the Statutory Visiting Committee. This Committee is made up of a broad cross section of representation from industry and the academic world and is supported by a Board of Assessment and a number of Evaluation Panels. It was my privilege to chair for several years the Panel for the Evaluation of the National Engineering Laboratory of the Bureau of Standards.

It is my considered opinion that one high level board is all that is needed to manage the new organization. I would not create a new board reporting through independent channels and in conflict with the Statutory Visiting Committee of the Bureau of Standards. It may well be that a new high level board could be formed combining the new activity or the responsibility of the Statutory Visiting Committee and its title changed to accommodate the expanded scope of the new organization.

I am enthusiastic about the recognition on the part of yourself and others of the role that science and technology plays in the development of manufacturing and business competitiveness. I believe, however, that beyond the proposals made in H.R. 2068 we must begin to think in yet broader terms.

The real problem as I see it is the lack of recognition on the part of the parent Department of Commerce on the true role of science and technology in the business world. The Department of

Commerce has been preoccupied to a great degree with matters of trade, tariffs, customs and other manipulative activities, while the technology of our manufacturing effort drifted into obscurity. Our foreign competitors, particularly the Japanese, recognized the true role of science and technology in the development of superior products and the manufacturing processes to produce them. The Japanese have taken the science and technology of our United States and put it to work, while we devoted our time and effort to the almost counterproductive activity of business manipulation.

It may be a bit grandiose and very difficult to do, but I believe we must start now to change the basic culture of the Department of Commerce to truly take a leadership role in bringing to fruition the application of science and technology to our industrial processes. How this is done is beyond my scope of understanding at the moment, but I believe it is absolutely essential if we are to carry out our newly formed objectives of regaining competitiveness in world markets.

I appreciate very much the invitation to testify before your Committee and to offer these comments on H.R. 2068.

Best personal regards.

Cordially,

Gordon H. Millar

Gordon H. Millar

GHM/vmm

C: Messrs. Boehlert, Glickman, Brown, Morrison, Ritter
Mr. Lamar Smith, Mr. W. Woolam, Mr. F. Press, Mr. R. M. White,
Ms. C. Pompliano

Mr. **Walgren**. Thank you, Mr. Ritter.

Mr. Price?

Mr. **Price**. Thank you, Mr. Chairman.

Dr. Branscomb, I am intrigued by your comments at the very end of your testimony about the Department of Commerce and some of the problems you perceive in giving the Bureau of Standards the kind of status and support that it needs there. You make a couple of hints about the culture of that department and some of the impatience you find among business experienced executives, as you put it, with an agency of this sort. I wonder if you could just elaborate on that a little and then I would like to pursue the implications of that for where the Bureau ought to ultimately be located?

Dr. **Branscomb**. Well, I think over a good many years it would be fair to say that certainly the Secretaries of Commerce that I've personally known, and it's a good many of them, they're attitude, I would characterize their attitude towards the National Bureau of Standards as, we are aware that this is a very fine institution. Everybody tells us that. And, we've every reason to believe that one of my responsibilities as secretary is to make sure it stays that way. I have stewardship for something important here. But, this important thing is a scientific enterprise of some kind, which is clearly not, in my view, a central instrument for the conduct of the main things that I view my mission as Secretary of Commerce to achieve. And, because I believe most secretaries of Commerce put their first priority on trying to have, if not the major voice, at least a major voice in national trade policy. It's clear from both the constitutional and legislative point of view, they have a major responsibility for export promotion, and for other things related to international trade.

Because their constituency is the business community, and as the former Deputy Director of the National Bureau of Standards, Dr. Lawrence Cushner, once said to me in private, and I've quoted him often in public, the Department of Commerce is the only agency of Government, the only department of Government with a hostile constituency. Now, under those circumstances, with the business community's principal interest being to get the Secretary of Commerce to help persuade the rest of government not to intrude upon the prerogatives of the private sector. You do not have a climate within the Department for an activist approach to technology issues that may be of interest to the technical people in industry. And, unhappily in most companies, even though the senior vice president for engineering may be a key member of the management team, it is tax issues, trade issues, anti trust issues, things of that kind that dominate the chief executive officer's attitude toward what goes on in Washington. CEO's don't spend much time worrying about how Washington might improve the technical climate within which that company operates. There are exceptions, particularly in companies run by technical people.

And, I think, under that entire set of circumstances, it's easy to understand why the Department of International and Trade and Industry might be proposed by the Department of Commerce and have as a key feature, divesting itself of all its technical agencies. So, while I think the Commerce Department has—I'm told, let me be very clear about this, I'm told by my friends at the Bureau of Standards, whom I shouldn't quote directly, but they tell me that they are getting excellent understanding and sympathy from the leadership of the department. I'm not relaying here any complaints from the Bureau of Standards about the current department. My impression is, they're very pleased with the understanding they get from the Deputy Secretary and others. But, I do believe that we are very far from a department that can seize as its mission having a major voice in the Federal Government's strategy for deploying the 50 percent of the national R&D that is government's, in such a way that it will have maximum benefit to the private sector. That's a plausible role for the Department of Commerce. It would involve a lot of dialogue with the Department of Defense, which dominates that Federal R&D budget, to the tune of some 73 percent. Nevertheless, it is not a role—this is not a subject in which you hear officers of the Department of Commerce being leading spokesmen in the national debate about technology policy. And, until that becomes what they believe is a natural role, then I tend to be a little pessimistic that they're going to drive the broadening and deployment of the Bureau of Standards to this set of issues.

Mr. **Price**. Well, the explanation you give, though, raises a much broader question. And, that is, does this kind of role for the Bureau of Standards, the kind of positive role it can play, does it have a constituency, particularly does it have a strong constituency in the American business community?

Dr. **Branscomb**. The strange thing about it, is I think it does. It has a powerful constituency among research directors, among engineering managers, among technical people trying to solve problems, and in some cases, among CEO's and general executives. And, one of the reasons it has this strong support in that constituency is because the Bureau is nonintrusive and is not a highly visible fixture in debates about how to fix the lagging behavior of private industry. Industry finds the Bureau a comfortable partner, and it is precisely because of that, it doesn't have a visible, politically active, industrial constituency. I think it's a catch-22 of some proportions, and that's one of the reasons why you hear me advocating over and over again, look to the states. Industrial policy is alive and well in the states. It's well accepted there. I can name you a dozen states whose governors are out there every day explaining to the voters how education, high tech and a favorable business climate is the route to employment in the State. And, in those States I think you can create an environment where the Bureau of Standards can play a supporting role of greater visibility and leverage.

Mr. **Price**. Well, back to this specific organizational question that we're facing. Does the situation, as you perceive it in the Commerce Department, lead you to any particular organizational preference as to whether the Bureau of Standards really belongs there, or whether some kind of other location within the Federal Establishment would be preferable?

Dr. **Branscomb**. And my answer is, if we have an administration and Congress minded to strengthen and change the character of the Department of Commerce so that it takes on a commerce and technology role—it's the name of the department that we need to be debating here, not the name of the Bureau of Standards. It's name, of course, is symbolic for adoptive policy. If indeed, in this administration, there were that determination, then I would say, for goodness sakes, don't tear up the Department of Commerce, strengthen the Bureau's role, make it move visible and install the other policy arms, the analytical work that Mr. Ritter talks about, and other activities you want in parts of the department that come together with the Bureau in a coherent technology program. And, of course, it's also possible that we will see candidates for office in the next 2 years who have their own views about what the right role for the Department of Commerce is. And, I would think we might hear that from both parties. And, so there may well be a political opportunity to discuss a changing character of this department.

But, if that in fact is not to come, then I think we better look at some other options. And, there are a variety of them. One of them, clearly, is a simple association of NBS and NSF, not so simple, you have to change the NSF statute to make it possible. It has many ramifications. There are other possibilities too, which I think are worth thinking about, though premature to propose; strengthen civil technology agencies based on today's energy agency in NASA, for example, with a broader mission and a pooling of the national laboratories and a deployment of their talents to a much broader spectrum of civil issues. There's a spectrum of choices to choose from.

Mr. PRICE. That's very helpful.

Thank you, Mr. Chairman.

Mr. WALGREN. Thank you, Mr. Price.

Well, on behalf of all of us, we appreciate your being with us this morning. Thank you.

Dr. BRANSCOMB. Mr. Walgren, could I add one last comment?

Mr. WALGREN. Surely.

Dr. BRANSCOMB. Because the subject of metric really didn't come up and there's just one little thought I want to leave you with. And, that is, in all of the discussions we've got about the technology problems of this country, it's pretty hard to put that on the table and say that's the most important. But, I was told the other day by someone who may be well informed, that there either has been a decision or is about to be a decision in NASA that our space station will be built to English standards, because some contractor said it would be cheaper and quicker to do it that way instead of doing it metric. I hope you will ask NASA a question about that. I think it would be a travesty if it turned out that way.

Mr. RITTER. Mr. Chairman?

Mr. WALGREN. Mr. Ritter?

Mr. RITTER. As the cosponsor of the metric bill, along with my colleague from California, Mr. Brown, we will definitely ask that question right away. Thank you.

Dr. BRANSCOMB. It would be too bad if only engineers from CHAD could work on it.

Mr. WALGREN. Thank you all very much.

The next panel, Daniel DeSimone, Executive Director of the American Association of Engineering Societies, Kenyon Taylor, Chairman and CEO of North American Tool Co., and Frank Feigin, Engineering Manager of International Products for Digital Equipment Corp.

Gentlemen, welcome to our process. We appreciate your joining us and your prepared statements will be inserted immediately following your oral presentations. You can please feel free to summarize and highlight those points that you feel can best be underscored in this kind of a verbal presentation, and I hope you might be able to do that in five plus minutes, or thereabouts, but we have flexibility on that.

Let's start in the order that I called you to the table, and Mr. DeSimone, welcome.

[Material referred to follows:]

100TH CONGRESS
1ST SESSION

H. R. 1964

To amend the Metric Conversion Act of 1975 to increase the use of the metric system in Government programs.

IN THE HOUSE OF REPRESENTATIVES

APRIL 7, 1987

Mr. BROWN of California (for himself and Mr. RITTER) introduced the following bill; which was referred to the Committee on Science, Space, and Technology

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A BILL

To amend the Metric Conversion Act of 1975 to increase the use of the metric system in Government programs.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Metric Usage Act of 1987".

SEC. 2. FINDINGS.

Section 2 of the Metric Conversion Act of 1975 is amended by adding at the end thereof the following new paragraphs:

"(3) World trade is increasingly geared towards the metric system of measurement.

"(4) Industry in the United States is at a competitive disadvantage when dealing in international markets because of its cumbersome, non-standard measurement system, and is sometimes excluded when it is unable to deliver goods which are measured in metric terms.

"(5) The inherent simplicity of the metric system of measurement and standardization of weights and measures has led to major cost savings in certain industries which have converted to that system.

"(6) The Federal Government has a responsibility to develop procedures and techniques to assist industry as it voluntarily converts to the metric system of measurement.

"(7) The metric system of measurement can provide substantial advantages to the Federal Government in its own operations.".

SEC. 3. POLICY.

Section 3 of the Metric Conversion Act of 1975 is amended to read as follows:

"SEC. 3. It is therefore the declared policy of the United States—

"(1) to designate the metric system of measurement as the preferred system of weights and measures for United States trade and commerce;

"(2) to require the use of the metric system of measurement for business purposes in all Federal Government programs and procurements by the end of the fiscal year 1992, except to the extent that such use is impractical or is likely to cause significant inefficiencies;

"(3) to seek out ways to increase understanding of the metric system of measurement through education, assistance to those being asked to convert, and use of dual systems of measurement on road signs and in Government publications; and

"(4) to permit the continued use of traditional systems of weights and measures in non-business activities.".

SEC. 4. IMPLEMENTATION.

The Metric Conversion Act of 1975 is further amended by redesignating section 12 as section 13, and by inserting after section 11 the following new section:

"SEC. 12. (a) As soon as possible after the date of the enactment of this section, each agency of the Federal Government shall issue regulations to carry out the policy set forth in section 3 (with particular emphasis upon the policy set forth in paragraph (2) of that section), and as a part of its annual budget submission for each of the first 7 fiscal years beginning after such date shall report to the Congress on the actions which it has taken during the previous fiscal year, as well as the actions which it plans for the fiscal year involved, to implement fully the metric system of measurement in accordance with that policy. As used in this section, the term 'agency of the Federal Government' means an Executive agency or military department as those terms are defined in chapter 1 of title 5, United States Code.

"(b) At the end of the fiscal year 1992, the Comptroller General shall review the implementation of this Act as amended by the Metric Usage Act of 1987, and upon completion of such review shall report his findings to the Congress along with any legislative recommendations he may have.".

○

STATEMENT OF DANIEL DeSIMONE, EXECUTIVE DIRECTOR, AMERICAN ASSOCIATION OF ENGINEERING SOCIETIES, WASHINGTON, DC

Mr. **DeSimone**. Mr. Chairman and members of the subcommittee, good morning. It's a pleasure to be with you and I will skim my remarks.

It was 20 years ago that Congress, largely through the initiative of this committee, directed the Secretary of Commerce to assess the increasing worldwide use of the metric system and recommend to Congress what ought to be done about it.

I had the privilege of serving as the director of that study at the National Bureau of Standards, at a time incidentally, when Lewis Branscomb had just been installed as the new director of NBS, and I'm sorry he's not here. It was a very exciting time, as you can imagine, and witnessed this morning, because of his infectious enthusiasm. He wanted that study to succeed and we did our best. It was a massive technology assessment and in the concluding volume, I summarized our experience and what we had learned.

I am pleased, therefore, to have been invited, because of that experience, to testify before this subcommittee on H.R. 1964.

On the basis of the Metric Study, the Secretary of Commerce recommended that there be a coordinated national program to facilitate the change to predominant metric usage over a 10-year period.

The guiding principles were that there be a voluntary changeover, that the rule of reason apply, and that there be no subsidies.

Two decades have now passed since this committee spawned the Metric Study Act. Sixteen years have elapsed since the Secretary of Commerce urged a 10-year changeover, and still we cling diffidently to inches and pounds, drifting aimlessly, without a general plan or a target date for the nation. Meanwhile, America becomes more and more dependent upon trade with a resolutely metric world, as Dr. Branscomb indicated in his closing comment. To be sure, a metric changeover will not alone solve our problems in world trade, but it will help. There are no magic formulas, obviously. We need to do many things, and facilitating a rationalization of our measurement system is one of them.

And, so, H.R. 1964 is a step in the right direction, and Mr. Brown and Mr. Ritter are to be commended for introducing this bill.

It is especially significant that H.R. 1964 would amend Section 3 of the Metric Conversion Act of 1975 to designate the metric system of measurement as the preferred system. This addresses a fundamental cause of the national schizophrenia regarding measures. Are we or are we not committed to a changeover? Clearly, there would be less confusion if everyone knew that at some point in the future all Americans will have agreed to talk the basic language of measurement in some consistent way. We agree on a common alphabet, we accept the dictionary for the spelling and meaning of words, if we live in the same time zone, we set our clocks the same. These are conventions for making life simple and we take them for granted, yet in the past each of them was adopted in the face of strenuous objections.

There are opponents of the metric system who still maintain that it is not clear whether the rest of the world will continue to embrace the metric system and that there really is the possibility that they may recant and adopt the U.S. customary system instead. H.R. 1964 will help to quell this delusion by specifying that the metric system shall be the preferred system in the United States.

A distinctive and commendable feature of this bill, H.R. 1964, is that it focuses on the pivotal arena of Federal Government programs and procurement. It is pivotal because in almost every field of U.S. commerce, the Federal Government is the largest single consumer of goods and services. As such, it is in a position to encourage change and to alleviate doubts, especially on the part of the small businesses, about the extent and permanence of a metric market in the United States.

The target date of 1992 is reasonable. However, past experience with metric legislation may suggest that this provision be reworded to read, by the end of the fifth year after the enactment of this act. Indeed, there are many people who feel that if we become predominantly metric by the turn of the century, we will have done ourselves and American industry a great favor.

It is an appealing quality of H.R. 1964 that it incorporates the rule of reason in its application. Thus, the bill acknowledges the desirability of voluntary conversion on the part of industry, does not require use of the metric system where such use would be impractical or cause significant inefficiencies, and permits the continued use of traditional systems of weights and measures in nonbusiness activities.

In the Metric Study we emphasized that even in a concerted program of metric change, some things would be changed rapidly, some slowly, and some never. In most cases, things would be replaced with new metric models only when they wore out or became obsolete. This would certainly be done, for example, in the case of existing buildings, aircraft carriers, railroad locomotives, power generating plants, and even such things as typewriters.

Some units may continue to be used wherever they make communications and calculations clear and easy. Even in metric countries meteorologists still speak of "bars," and astronomers prefer to talk of distance in light years, instead of many trillions of kilometers. Such convenient units as these are not likely to be discarded, nor should they be.

As a final observation, Mr. Chairman, the bill calls for seeking out ways to increase understanding of the metric system of measurement through education, assistance to those being asked to convert, and use of dual systems of measurement on road signs and in Government publications. This is essential for public acceptance of this legislation. Paradoxically, however, dual recitations of measurement units will make it difficult to make the switch, for we are naturally inclined to focus on the more familiar term as long as it is given to us. The telephone weather announcer's "50 degrees" makes the following, "10 degrees celsius" irrelevant and forgettable. Nevertheless, public acceptance will require the dual-use approach, at least during the transition period provided for in H.R. 1964.

In summary, Mr. Chairman, H.R. 1964 is a step in the right direction. It is modest in its goals, but astute in its focus, and its insistence that the rule of reason be the guiding principle for any changeover is commendable. By setting an example, it may well provide the impetus and encouragement for other sectors.

Thank you.

[The prepared statement of Mr. DeSimone follows:]

TESTIMONY OF

DANIEL De SIMONE

EXECUTIVE DIRECTOR

AMERICAN ASSOCIATION OF ENGINEERING SOCIETIES

ON

H.R. 1964, a bill to amend the Metric Conversion Act of 1975

to increase the use of the metric system in government

BEFORE THE

SUBCOMMITTEE ON SCIENCE, RESEARCH, AND TECHNOLOGY

OF THE

COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

April 28, 1987

Mr. Chairman and Members of the Subcommittee:

TWENTY YEARS AGO Congress passed the Metric Study Act (P.L. 90 - 472) which directed the Secretary of Commerce to conduct a comprehensive assessment of the increasing worldwide use of the metric system and to recommend to Congress a course of action that would be appropriate and in the best interests of the United States.

I was privileged to serve as the director of that study, which had been assigned to the National Bureau of Standards, and in which thousands of individuals, firms, associations, agencies, and organized groups participated from every sector of U.S. society. It was at that time -- and perhaps remains -- the most massive technology assessment ever undertaken, in the strict sense of that term. There were 12 volumes of reports on different aspects of the assessment, and the concluding volume, which I wrote, summarized our experience and what we had learned.

I am pleased, therefore, to have been invited, because of that experience, to testify before this Subcommittee on H.R. 1964, a bill to amend the Metric Conversion Act of 1975 to increase the use of the metric system in government.

On the basis of the Metric Study, the Secretary of Commerce recommended that there be a coordinated national program to facilitate the change to predominant metric usage in America over a ten - year period. In particular, the Secretary recommended:

*That the United States change to the International Metric System deliberately and carefully;

*That this be done through a coordinated national program;

*That the Congress assign the responsibility for guiding the change, and anticipating the kinds of special problems described in the report, to a central coordinating body responsible to all sectors of our society;

*That within this guiding framework, detailed plans and timetables be worked out by these sections themselves;

*That early priority be given to educating every American schoolchild and the public at large to think in metric terms;

*That immediate steps be taken by the Congress to foster U.S. participation in international standards activities;

*That in order to encourage efficiency and minimize the overall costs to society, the general rule should be that any changeover costs shall 'lie where they fall';

*That the Congress, after deciding on a plan for the nation, establish a target date ten years ahead, by which time the U.S. will have become predominantly, though not exclusively, metric;

*That there be a firm government commitment to this goal.

Two decades have now passed since this Committee spawned the Metric Study Act. Sixteen years have elapsed since the Secretary of Commerce urged a ten - year changeover. Twelve years have come and gone since the Metric Conversion Act of 1975. And still we cling diffidently to inches and pounds, drifting aimlessly, without a general plan or target date for the nation. Meanwhile, America reverberates with calls for 'competitiveness' and becomes more and more dependent upon trade with a resolutely metric world. Yet the open markets that we demand from Japan and other countries are metric markets, and the sales to be made there are to people who think in metric terms. To be sure, a metric changeover will not alone solve our problems in world trade -- but it will help to equip us for the challenge. There are no magic formulas : we need to do many things, and facilitating a rationalization of our measurement system is one of them.

And so, H.R.1964 is a step in the right direction, and Mr. Brown and Mr. Ritter are to be commended for introducing this bill.

It is especially significant that H.R. 1964 would amend Section 3 of the Metric Conversion Act of 1975 to designate the metric system of measurement as the preferred system. This addresses a fundamental cause of the national schizophrenia regarding measures. Are we or are we not committed to a changeover? Clearly, there would be less confusion if everyone knew that at some point in the future all Americans will have agreed to talk the basic language of measurement in some consistent way. We agree on a common alphabet; we accept the dictionary for the spelling and meaning of words; standard nuts are manufactured to fit standard bolts; if we live in the same time zone, we set our clocks the same. These conventions for making life simple are now taken for granted, yet in the past each of them was adopted in the face of strenuous objections.

There are opponents of the metric system who still maintain that it is not clear whether the rest of the world will continue to embrace the metric system and that there really is the possibility that they may recant and adopt the U.S. customary system instead. H.R. 1964 will help to quell this delusion.

A distinctive and commendable feature of H.R. 1964 is that it focuses on the pivotal arena of Federal Government programs and procurement. It is pivotal because in almost every field of U.S. commerce, the Federal Government is the largest single consumer of goods and services. As such, it is in a position to encourage change and to alleviate any doubts, especially on the part of small businesses, about the extent and permanence of a 'metric market' in the United States.

The target date of 1992 is reasonable. However, past experience with metric legislation may suggest that this provision -- Subsection (2) of Section 3 -- should be reworded to read 'by the end of the fifth year after the enactment of this Act' or, if technically preferable, 'by the end of the fifth fiscal year after the enactment of this act.'

It is an appealing quality of H.R. 1964 that it incorporates the 'Rule of Reason' in its application. Thus, Section 2, Subsection (6), acknowledges the desirability of voluntary conversion on the part of industry; Section 3, Subsection (2) does not require Federal Government use of the metric system where such use would be impractical or cause significant inefficiencies; and Section 3, Subsection (4) permits the continued use of traditional systems of weights and measures in non-business activities.

In the Metric Study we emphasized that even in a concerted program of metric change, some things would be changed rapidly, some slowly, and some never. In most cases, things would be replaced with new metric models only when they wore out or became obsolete. This would certainly be true, for example, of existing buildings, aircraft carriers, railroad locomotives, power generating plants, and even such things as typewriters.

In many instances industry and commerce would make metric changeovers much as they would for ordinary reasons of economy and efficiency. A pump in a chemical factory, for example, might with careful maintenance last ten years before it wore out and had to be replaced. But if a critical part failed after, say, five years, the user might well decide to buy a new pump of improved design and lower running cost, rather than fix the old one. And if he were going metric and metric pumps were available, the pump would, of course, be one built to metric standards. Somewhat analogous is the problem of rewriting real estate deeds in metric dimensions -- meters instead of yards, and hectares instead of acres. There would be no good reason to do this until the property changed hands and was resurveyed.

Some units that are not part of the International Metric System may continue to be used wherever they are believed to make communications and calculations clear and easy. Even in metric countries meteorologists still speak of "bars," one bar being roughly normal atmosphere pressure, and of the "millbar," which is one-thousandth of a bar. Astronomers prefer to talk of distance in "light years," instead of many trillions of kilometers. Such convenient units as these are not likely to be discarded, nor should they be.

As a final observation, Mr. Chairman, Subsection (3) of Section 3 -- "to seek out ways to increase understanding of the metric system of measurement through education, assistance to those being asked to convert, and use of dual systems of measurement on road signs and in Government publications" -- is essential for public acceptance of this legislation. Paradoxically, however, dual recitations of measurement units will make it difficult to make the switch, for we are naturally inclined to focus on the more familiar term as long as it is given (the telephone weather announcer's "50 degrees" makes the ensuing "10 degrees celsius" irrelevant and forgettable). Nevertheless, public acceptance will require the dual-use approach, at least during the transition period provided for in H.R. 1964.

In summary, Mr. Chairman, H.R. 1964 is a step in the right direction. It is modest in its goals but astute in its focus; and its insistence that the rule of reason be the guiding principle for any changeover is commendable. By setting an example, it may well provide the impetus and encouragement for other sectors than the Federal Government to follow suit.

Mr. **Walgren**. Thank you very much. We appreciate that.
We'd like to turn now to Mr. Taylor.

STATEMENT OF KENYON TAYLOR, CHAIRMAN AND CEO OF NORTH AMERICAN TOOL CORP., SOUTH BELOIT, IL

Mr. **Taylor**. Thank you, Mr. Chairman.

My name is Kenyon Taylor and I am presently Chairman of the Board and CEO of North American Tool Corp. of South Beloit, IL, which I founded in 1986, and which still is, unfortunately, a small business. Prior to that point in time I was chairman of the Regal Beloit Corp., which I founded in 1955. That's now currently the world's largest manufacturer of special cutting tools, particularly in the thread tool area, which of course is very measurement sensitive.

I also serve an active position and am a lifetime member of the U.S. Metric Association and I'm presently Chairman of the Board of the American National Metric Council. Two of my books, which I think most of you have seen, USA Goes Metric and Discover Why Metrics, have a combined circulation of approximately 2 million copies. I've also been very fortunate in being able to visit Australia, New Zealand, Canada and Great Britain and to observe their and actual conversion to the metric system of measurement. I was also honored by two Presidents as their appointment to the U.S. Metric Board.

The important thing to me today is having the opportunity to discuss some of the advantages of metric use and particularly the positive impact that I believe that government adoption of this simple system of measurement should have on American industrial competitiveness.

I'd like to say at this point in time, let's not give up on this competitiveness word. With all due respect to the Ph.D.'s, the part of the country that I come from, the word is accepted. It's understood and the semantics of trying to change, I think would cause some problems at this point in time, Mr. Chairman.

Unfortunately, Representative Perkins isn't here today, so I'm going to take a little advantage of him. As you know, and Representative Perkins will be happy to tell you at the first opportunity, the renowned Kentucky Derby race is this Saturday, May 2nd. Now, you're all familiar with the mile, it came to us from the ancient Greeks. You surely know about the quarter-mile, that represents two furlongs, and that came from Queen Elizabeth the First. And, you perhaps know a furlong equals one-eighth of a mile or 220 yards, and the yard was standardized by King Henry the First.

We could also talk about inches and feet and yards, and my northern neighbors in Wisconsin still measuring in ax handles they think. But, in this race, in the Kentucky Derby, all of the competitors are running under the same conditions. They run the same distance and they carry the same weight, 57 kilos, 126 pounds. This makes a fair and equal competition and the best participant should win. There's another kind of a horse race, or a race, called a handicap, in which generally the more talented competitors are assigned a greater difficulty or weight, and this supposedly makes them and their less talented competitors more nearly equal. This is supposed to allow horses a greater chance to win and make the race more exciting.

Now, you would ask what's the relationship between horse racing and American industry. It's basically this: that I feel very strongly that American manufacturers, these days, are handicapped in the American marketplace because they operate under an obsolete system of measurement, the inch/pound system, while 95 percent of the world uses the metric system. There are only three countries left which have not adopted metric, Burma, Brunei and the United States, two of our greatest industrial competitors, obviously. Brunei will switch in July this year.

The bill you're considering, H.R. 1964, The Metric Usage Act of 1987, encourages Government use of metric in its programs and procurement. And basically, because the Federal Government is the country's largest customer, metric use would provide an impetus to manufacturers and service suppliers to use metric also. We hope that the Government would become the focal point for much of the metric activity which would take place over the next few years. And, by its metric use the Government would enhance the private sector's increased competitiveness and allow greater U.S. industrial participation in markets abroad.

As many of you know, and certainly as Mr. Brown and Mr. Ritter do, the international measurement system for advanced technology is the metric system, just as English is becoming the language. My question is, why do we handicap our high technology industries, many of which are also small businesses, by making it more difficult for them to operate in the metric system. Why are we handicapping American industry by failing to encourage metric use? It's a horse race.

There are a few facts that might be of interest to you:

In 1866, Members of Congress enacted legislation making it legal to use the metric system to transact business. Incidentally, this august body has never passed legislation to make the inch/pound system the legal system of measurement. That might make quite a class action suit against 132 million people, all using the same system.

Many countries with which we do business require metric. Our engineering firms working in Iraq, for example, know that the country will fine an offender approximately $550, confiscate the equipment he uses, and impose a 6-month jail term for each failure to use the metric system in that commerce. That's a lot of jail time for one shipment of the wrong bolts.

Metric will be the only legal measuring system for use within the European Economic Community after 1990. This is extremely important to us. It is a nontariff barrier, which can critically hurt the remaining export business that we have in that market. China, obviously, one of our potentially most exciting potential export markets, expects to be totally metric by the year 1990.

Over half of our exports, 60 percent of the $180 billion worth, we still sell annually abroad, are to advanced industrial nations, all metric, such as Canada and the common market again.

One-half to two-thirds of all of our exports are measurement sensitive, and a proportion which has remained steady since 1955.

Our use of the inch/pound does not prevent metric inputs, while our continued use of the inch/pound handicaps our exports.

Each additional billion dollars in exports creates 26,000 jobs. This is a Department of Commerce figure. When Dr. DeSimone and I worked so hard in 1975 to get the original metric bill through Congress, we had a positive trade balance at that point in time of $25 billion. Sixteen years later, we have a negative situation of about $169 billion and we tried, but we cannot do business with our products in a nonmetric world. We know that that loss of $200 billion a year in the short period of 11 to 12 years, according to Bureau of Standards and Department of Commerce figures, represents about 8 million jobs. We're not naive enough to think that all of those jobs were because of our metric failure to provide products acceptable in that market which we formerly had, but I like to think it's a substantial part of that market. Jobs is the key word, and I think they're going to be extremely important in this country in the next 2 years.

Those areas in which our export prospects are brightest are high technology fields, and it is in these fields too, where the greatest rate of increase for small business formation takes place.

Engineering firms find their designers work faster, more efficiently, and more accurately in metric than in inch/pound. There are fewer conversions to make in the course of their work. A great majority of our manufacturing facilities today, are familiar with the metric system. They are willing to use it. They recognize the advantages and, in my personal experience, having made several hundred appearances at seminars and TV and radio, and calling on companies that have converted, we find that the estimated cost of conversion in industry usually is less than 2 percent of the best educated estimates submitted by engineers prior to conversion. The cost of converting a product or a factory to the full use of the metric system measurement can be recovered in days by the efficiencies that the system produce.

Now, H.R. 1964 does not encourage government use of metric because there's some dedication to a noble idea such as an international standardization. That is one of the blocks that we've had against metric legislation in the past, and H.R. 1964 does not do it merely to follow the leaders. It's simply because it makes good business sense to do it. These industries and firms which have implemented metric already did so in their own economic self-interest. And, the obvious question is, Why should our Government do any less? I would hope our Government will not cling to an outmoded measuring system long past the time it makes good economic sense. The processes of Government and business are exciting enough without adding this unfair handicap.

We're now engaged in a much greater race, that race for industrial survival. Our failure to implement the Metric Conversion Act of 1975 has left us 10 lengths behind at the start. It seems to me, imperative that Congress remove the unfair burden, the excess weight of our obsolete measurement system, and then American business can win this race only if Government takes the lead to remove this handicap and leads this country to the use of the metric system of measurement.

Mr. Chairman, I sincerely appreciate the opportunity to be here today. I think H.R. 1964 is a good move. I think you can gather from my track record, no pun intended on that, I am pretty much sold on the use of this system. I've been privileged to travel pretty much throughout the world, making a number of appearances and analyses of the effective metric conversion. We told the world in 1975 that the United States was going to switch to the use of the metric system in that act. A hundred-odd countries in the world changed to the full use of that system, and we didn't, and we're isolated. And we can't sell in those countries, and it's the greatest nontariff barrier that we could possibly have created for ourselves, because we don't speak the metric language abroad.

Thank you very much.

[The prepared statement of Mr. Taylor follows:]

REMARKS BY

K.Y. TAYLOR

CHAIRMAN OF THE BOARD AND C.E.O.

NORTH AMERICAN TOOL CORPORATION

TO THE

U.S. HOUSE OF REPRESENTATIVES

Subcommittee on Science, Research, and Technology

Hearings on

H.R. 1964

The Metric Usage Act of 1987

April 28, 1987

north american tool corporation

dearborn ave. p.o. box 116
south beloit, il 61080 phone 815-389-2300

K. Y. Taylor
Chairman & CEO

Good morning, my name is Kenyon V. Taylor, I serve as Chairman of the Board and C.E.O of North American Tool Corporation of South Beloit, Illinois which I founded in 1986. Prior to that I was Chairman of Regal Beloit Corporation, which I also founded in 1955, and is now the world's largest manufacturer of special cutting tools.

Two of my books, "USA Goes Metric" and "Discover Why Metrics", have had nearly two million copies circulated. I have been fortunate in visiting Australia, New Zealand, Canada, and Great Britian to observe their conversion to the metric system. I was honored by appointment to the US Metric Board by two presidents.

I appreciate the opportunity to discuss some of the advantages of metric use, particularly the positive impact government adoption of this simple measurement system should have on American industrial competitiveness.

As you may know -- or no doubt Congressman Perkins will be happy to tell you -- the renowned Kentucky Derby horse race takes place this Saturday, May 2. You're all familiar with the mile -- it came to us from the ancient Greeks. You may know the quarter-mile represents two furlongs -- the furlong having been established by Queen Elizabeth the First. And you may know a furlong equals one-eighth of a mile or 220 yards -- the yard having been standardized by King Henry the First and refined by his descendent King Henry the Fourth.

In this race all the competitors run under the same conditions: they run the same distance and carry the same weight -- 57 kilograms, or 126 pounds. This is fair and equal competition and the best participant should win. There is another type of race called a "handicap" in which the more talented competitors are assigned a greater difficulty, usually in the form of great weight, to make them and their less talented competitors more nearly equal. This is supposed to allow all horses a greater chance to win and make the race more exciting.

You might ask the relationship between horse racing and American industry. It is this: many American manufacturers these days are handicapped in the international marketplace because they operate under an obsolete measuring system -- the inch/pound system -- while 95% of the world uses the metric system of measurement. There are three countries in the world which have not adopted metric -- Brunei, Burma, and the United States. And this number will shortly be down to two -- Brunei will adopt metric officially in July.

The Bill you are considering, H.R. 1964, "The Metric Usage Act of 1987," encourages government use of metric in its programs and procurement. Because the Federal Government is the country's largest customer, its metric use would provide an impetus to manufacturers and service suppliers to use metric also. Thus the government would become the focal point for much of the metric activity which would take place over the next few years. And by its metric use the government also would enhance the private sector's increased competitiveness and allow greater U.S. industrial participation in markets abroad.

The government currently encourages small business participation in the procurement process. Obviously this bill would encourage these firms to implement metric to continue to retain their government market. But U.S. government metric use also would enhance small business' export markets. When a small firm saturates the domestic market, it can either become satisfied and stand pat, or it can seek additional markets, which means it must look abroad. And what does it find but an international metric marketplace? Implementing two production lines, two billing procedures, two inventories, and two supply sources -- one in inch/pound and one in metric -- obviously is beyond the resources of many small firms. Implementation of metric at the Federal level would allow these firms to increase metric usage and then expand their markest abroad.

In fact, maintaining a dual system sometimes is beyond the resources of large firms. Yet the Census Bureau tells us the rate of formulation of American households is decreasing and these households are becoming smaller. Thus, the opportunites for continued growth and expansion which once existed for American businesses now are shrinking. Furthermore, many countries now supply for themselves the technology for which they once relied on the United States.

As many of you may know -- certainly as Mr. Brown and Mr. Ritter do -- the international measuring system for advanced technology is the metric system, just as English is becoming its language. Why should we handicap our high-technology industries, many of which also are small business, by making it more difficult of them to operate in the metric system? For that matter, why are we handicapping American industry by failing to encourage metric use? I ask you to consider these facts.

* In 1866, members of this body enacted legislation making it legal to use the metric system to transact business. By the way, this body has never passed legislation to make inch/pound the legal measuring system.

* Many countries with which we do business require metric. U.S. engineering firms working in Iraq, for example, know that country will fine an offender $550.00, confiscate equipment, and impose a six-month jail term for each failure to use metric. That's a lot of jail time for one shipment of the wrong bolts.

* Metric will be the only legal measuring system for use within the European Economic Community after 1990. China, one of our potentially most exciting export markets, expects to be totally metric by that year also.

* Over half our exports -- 60% of the $180 billions worth annually we sell abroad -- are to advanced industrial nations, all metric, such as Canada and the EEC.

* One-half to two-thirds of all our exports are measurement -sensitive, a proportion which has held steady since 1955.

* Our use of inch/pound does not prevent metric imports, while our continued use of inch/pound handicaps our exports.

* Each additional billion dollars in exports creates 26,000 jobs.

* Those areas in which our export prospects are brightest are high-technology fields such as telemetrics, robotics, bioengineering, space manufacture, and energy technologies, and it is in these fields too where the greatest rate of increase of small business formation takes place.

* Engineering firms find their drafters and designers work faster, more efficiently, and more accurately in metric than in inch/pound because there are fewer conversions to make in the course of their work.

* Of Fortune "1000" firms, 62% produce at least one metric product. About 32% of total net sales of these firms' product are metric. With those firms in the private sector which already use metric, about 10% of the United States' Gross National Product is metric.

Thus H.R. 1964 does not encourage government use of metric because of some dedication to some noble ideal such as international standardization, but simply because it makes good business sense to do so. Those industries and firms which have implemented metric already did so in their own economic self-interest. Why should our government do any less? As a taxpayer, I would hope our government will not cling to an out-moded measuring system long past the time it makes good economic sense. The processes of government and business are exciting enough without adding an unfair handicap.

Members of the Subcommittee, I hope you will keep some of these thoughts in mind as you consider H.R. 1964. They may be on your mind as you watch -- on what is mostly likely an imported metric television set -- the Kentucky Derby -- a nice two-thousand meter horse race.

Mr. **Walgren**. Thank you very much, Mr. Taylor. Those analogies will stick in mind.

Mr. Feigin?

STATEMENT OF FRANK FEIGIN, ENGINEERING MANAGER, INTERNATIONAL PRODUCTS, DIGITAL EQUIPMENT CORP., MAYNARD, MA

Mr. **Feigin**. Thank you.

You have a very short writeup that I have prepared. I need not go over all of the same topics that all of the other people have gone over. Let me try to explain what I actually do and try to clarify some points that have been covered earlier in the day.

The group that I'm associated with is in the group of international engineering consultants. I, as well as other people in our group, act as consultants to our corporation worldwide. We produce products literally in every one of the industrial countries in the world and I personally have worked in a number of the different engineering and manufacturing functions over my years in this business. I do not work in the so-called area of pure research, but have worked in the areas of applied research, design engineering and manufacturing.

The one area which has not been covered, as far as I'm concerned, in great detail, which is an area which I do work in is the area of international standards. And, this is a place where our competition in the world is beating us to the finish line, in that they have created what amounts to a nontariff trade barrier. The Europeans have grouped together and are very active in their operations known as IEC and ISO, and they have established standards which are in the metric system. And the pieces and parts used in products which agree with these standards are in metric. Our friends in the Far East have jumped onto the band wagon. They are also extremely active in the standards area. If we maintain the inch/pound system, we are pretty much confining ourselves to production in the United States.

The issues brought earlier in the day as to assistance to small industry, small business or what have you, I hope the committee realizes that in the electronics world, which I'm involved in, the production life of products is relatively short. That it is very necessary to realize that you do not convert over complete factories, but a production of a product and have them being produced for five or ten years. They must be flexible. Piece parts can exist for many, many years. There are piece parts in use in modern high-tech equipment today, that were designed back in the 40's. The piece parts remain the same, the finished product changes. The finished product is completely different. We used to, in this country, run productions of 7 to 15 years. In the electronics business today, you're lucky if you can get 2 years. Just a point of information.

Actually, I believe I'm here more to be able to answer the questions of the committee as to what is going on outside of North America in that I spend perhaps 50 to 75 percent of my time dealing with our European subsidiaries.

[The prepared statement of Mr. Feigin follows:]

(Suggested cover sheet for remarks before Congressional Committees)

REMARKS BY

Frank Feigin

NAME

Engineering Manager

TITLE

Digital Equipment Corporation

ORGANIZATION

to the

U.S HOUSE OF REPRESENTATIVES

Subcommittee on Science, Research, and Technology

Hearings on

H.R. 1964

The Metric Usage Act of 1987

April 28, 1987

Good Morning, ladies and gentlemen of the subcommittee. I am Frank Feigin, an Engineering Manager of Digital Equipment Corporation. We design, build and market commercial computer products. Digital Equipment's annual revenue for 1986 was in excess of 7 1/2 billion dollars, with revenues for the nine months ending March 28th approximately 6 3/4 billion dollars. At last count we had approximately 105 thousand employees world-wide, with design and manufacturing facilities in many of the major industrial countries. Thank you for this opportunity to discuss with you today HR 1964, "The Metric Usage Act of 1987".

I believe passage of HR 1964 would result in many benefits and advantages to both the public and private sectors of our economy, but I can speak most authoritatively about the advantage its adoption would give to Digital and similar corporations within the United States. Our purchasing ranges from component parts through sub-assemblies to finished product, and our sources are throughout the world. Various piece parts used in our products are controlled dimensionally by international standards, which are prepared in SI (metric) units. To adapt these parts for use in the design of finished products in the United States, we must take one of the following courses of action:

a) convert all dimensions to the inch/pound system;

b) create a design with a mixture of inch/pound and SI units; or

c) design completely in SI units

In the cases of (a) and (b), additional effort is required, and there are potential errors in conversion. There is also the problem that with such conversions a certain degree of accuracy is lost. A case in point; the mounting hole centerline for a particular part is established to be 40 mm, which, if converted to inches using only the equivalent of 25.4 mm to the inch, works out at 1.5748... inches. It clearly is far more convenient and logical to employ a single system to avoid the complication of conversion.

Some of our product designs are created outside the United States, and these are normally done in SI units. While it is possible to convert such designs from SI units to the inch/pound system for U.S. manufacture, it requires not only additional effort and expense, but also we find ourselves in the position that some of the component parts are available only outside the U.S. To have the components producted here requires either our directly funding the manufacturer, guaranteeing them a fixed purchase quantity or convincing them that there is a market opportunity. All of these are time-consuming and result in production delays and cost impact.

When the metric system of measurement has been established as the preferred system of weights and measures for United States trade and commerce, a US-based international company like Digital Equipment Corporation will at last have a language of measurement which needs no translation, and a confident purchasing system which needs no interpretation.

Mr. **Brown** [presiding]. Thank you, Mr. Feigin.

I don't think I need to tell the witnesses here that this committee is on the record and always supportive of metric conversion, and continues to be, and our basic problem is trying to determine the best strategy to move us forward, not as to whether or not we should move forward. We're convinced we should move forward, and I will not belabor that point. All of you have had long experience, and I know Mr. DeSimone and Mr. Taylor have. I've worked with them for most of the time that we've been involved in this, and we need some stroke of genius here to tell us how to get the ball rolling more rapidly.

Mr. **Feigin**. Excuse me. May I suggest we follow the Japanese example, and that was, the Government decided that the only way to be competitive was to be metric and they said, we will now be metric.

Mr. **Brown**. It's possible that the time is right now because of our own intense concern with competitiveness.

I was going to ask a sort of a generic question. We have a trade bill coming up this week, which is aimed at the competitiveness issue. It's probably misdirected, but that's the theory behind it. It has no input from this committee, and I was going to sort of ask if we could make one amendment to this bill that would help us with our competitiveness posture. What would that amendment be? Would it be a metric amendment, that would establish that we are going to be metric or would there be some other input that this committee could be responsible for that would help us move in that direction? Mr. Taylor?

Mr. **Taylor**. Well, I would like a little time to think about that. It's been in the back of our minds, Congressman, that something along that line has to be done in the future. It's interesting for me to note, having lived this thing for 20 years now, that the opposition has disappeared. Now, some of it in Arizona, I guess, has gone one direction and from my friend in Illinois, Representative Crane, I think he has reevaluated his position on this legislation.

Mr. **Brown**. You've been working on him a little bit?

Mr. **Taylor**. Well, I'm about ready to speak to him again, if he'll come around a little bit further on this. But, very frankly, and I don't want to belabor the point, Congressman Brown, but I've been involved in any number of call-in radio and TV programs in the last eight or ten years, but the ones more recently, in the last six months, there's been no—we're prepared always for the objections. This system is good enough. We've used it for a hundred years, and why change it. The last two that I've had and in speaking with some other gentlemen who have been involved in this type of thing, we haven't had a single call against the use of the metric system.

Mr. **Brown**. I take that as being a comprehensive scientific poll?

Mr. **Taylor**. No. It's not, but it frankly, it's from a guy who likes to hear that result, but is always prepared for the negative. And, it is disappearing very rapidly. I would be—remember, the Department of Education spent almost $100 million to teach our youngsters over the past 10 years use of the metric system. So, that's getting transferred to the parents in certain areas, and the fear—the only people who were ever against the use of metric are the people who didn't know it. And, as that education develops, the resistance to the use of the metric system is completely disappearing as far as I'm concerned. At least, they may be being charitable to me. But, I am not a bit concerned about saying that metric system of measurement should be implemented by a certain date. That doesn't concern me a bit. I've seen every country in the world, with one exception, they have converted successfully only because they set dates. If you were building this building, you would have a critical path. You would decide which floor to build first, and you'd determine that sequence. England was the only country that didn't do that and they are still floundering around and God bless them.

Mr. Brown. Well, that was our intent with the 1975 bill, but we didn't carry it through.

Mr. Taylor. Right.

Mr. Brown. Mr. Ritter, do you have any questions?

Mr. Ritter. Well, I want to commend our witnesses for their excellent testimony, and I think there is a special opportunity now, with the competitiveness debate underway. It's a tough word to spell, no less pronounce, but I think we may have another line of approach. I'm just a little concerned that things like this did not get into the trade legislation, because I think it would have been very appropriate.

Mr. Brown. It's not too late to make a shot at it, is it?

Mr. Ritter. Well, I don't—this is something I think we'll have to discuss in the camera, with some other issues.

I did take a look at—somebody put on our table, the Compressed Air Magazine, and here's a trade association and publication the compressor builders have come out against any kind of, it looks to me, mandate from the Federal Government. How much of this is still out there. This is organized, obviously well though out, quote, unquote, opposition to our approach?

Mr. Brown. If the gentleman will yield to me?

Mr. Ritter. Yes.

Mr. Brown. I read that editorial and then I read the article and it is not an unfavorable article. It appears at the onset that it's opposed because it's being cautionary, very cautionary. But, the position of that association is not opposed to the metric. Maybe they were unduly cautionary, I don't know, but I think they could easily——

Mr. Ritter. That is right. They do support the idea of going metric, but they don't seem to want to have the Government help the process along. That's really what we're talking about when we talk about competitiveness and about partnership between the Government and industry and moving exports in world trade.

Do we still have consensus trade association opposition, or is it at this point individualized?

[The Compressed Air Magazine article follows:]

Where Is the United States Today in Its Metric Conversion? What Has Happened – Good and Bad? What May Have Gone Wrong? What Might Have Been Done Better? And What Is Likely to Happen in the Future?

True or false:

Metric conversion has stalled.

Metric conversion has proceeded quite smoothly.

Both statements are essentially true, depending on which sector of the U.S. economy you are evaluating. Metric transition in consumer products has proceeded only to a limited degree in specific areas—liquor, soft drinks, film and cameras, pharmaceuticals, dual-dimensioning of packaged foods—but has made little progress in the marketing of vegetables, meat, gasoline, and the like. However, some large industries are nearly 100 percent metric.

Why has this happened? What, if anything, is wrong? To answer these questions, it must be remembered that the complete changing of its measurement system by the largest economy in the world, on a voluntary basis and without the background of any past experience for guidance and direction, is a very complicated activity. Whether the metric system is superior to the existing English (conventional) system or whether metric will become the predominant measurement system in the United States are determinations that seem to have already been made. Today, it is not a question of *whether*, but more of *when* the transition will be essentially complete.

HOW WE ARRIVED AT THE PRESENT SITUATION

Initially, one spoke of metric conversion ... something that happened suddenly, like religious conversion. Now, it is recognized that the process of changing the measurement system in a large country will take at least a generation. The word "conversion" no longer seems appropriate. "Transition" is a more gradual process. Most multinational firms are, at least to some degree, involved in metric transition.

It is evident that metric transition will occur industry by industry. The first one to move, and in a

Metric Transition

rapid manner, was the liquor industry. It had too many bottle shapes and sizes, and too many bottle heights that made shelf arrangement inefficient. The various components of the industry—bottlers, bottle manufacturers, distillers, distributors—came together and decided on the number of sizes of bottles (seven or eight), with only two heights, and obtained the necessary federal government approval (liquor distribution is a regulated activity) to adopt a new system of metric bottle sizes. The wine industry completed conversion in '78; distilled spirits, in 1980.

Another outstanding example of a successful industry initiative is the automotive. In the early '70s, most auto manufacturers decided on each having its own "world car" design. To be acceptable in the greatest number of countries, it had to be metric. So nearly all cars marketed in America and worldwide, whether made in the USA or not, have hard metric design. (Hard metric means that the design is made originally using metric dimensions and components; soft metric is a translation to metric dimensions from parts originally designed in inch.) Purchasers of these fully metric autos aren't told that they are metric when they are buying them. They learn about it when they try to use an inch socket wrench on a metric bolt.

The auto industry estimated, before conversion, that the costs would be significant. Their experience has shown, however, that the costs were much less than anticipated. In some cases, savings absorbed all the costs. One of the principal reasons for this was the conscious effort to eliminate unnecessary sizes of fasteners, wires, metal thicknesses, etc. This increased standardization gave economy of scale and fewer numbers of items to buy, make, stock, and service.

These two examples indicate that the primary reason for metric transition is economic. It was to the manufacturers' economic benefit to go to a single, worldwide system of design and measurement. In other industries, this economic benefit doesn't seem to have materialized. The machinery industry, for example, has educated itself in metric and is poised to move when new products are designed for the world market; however, the reduced demand for machinery in both domestic and export markets has slowed any significant number of new designs, which, in turn, has slowed the movement to metric.

In surveying industry experts and government officials, on a scale where 100 represents complete conversion, the U.S. multinationals are about 50 percent converted. This is opinion and can be argued. If you include in the process being aware of the metric system, having the knowledge and training in place to convert, having made some products in metric in most industries, and having some industries essentially 100 percent converted, the 50 percent figure seems a reasonable number.

In consumer products, however, the conversion percentage is more like 10. There are some items that are in true hard metric sizes—1 liter, 35 mm, etc.—but most domestically produced items are still in conventional units. Many packaged foods, such as cereals, show metric equivalents by the use of dual labeling, but the sizes are actually the old conventional ones and are not metric.

Consideration for the use of metric as the measurement system for the United States dates from its founding, when Jefferson, Adams, and Franklin all recommended its usage. However, since we had just been a colony of England and she was our principal trading partner, we adopted the English system. The recent trend toward metric seems to have started in 1968 when Congress, in response to what was happening in the rest of the world, passed a Metric Study Act. The same year, the American National Standards Institute (ANSI) formed a Metric Advisory Committee. In 1971, the Department of Commerce issued a report, "A Metric America . . . A Decision Whose Time Has Come".

In September of the following year, ANSI held a Metric Conference and organized the American National Metric Council (ANMC), which began operations in 1973. The role of ANMC has always been to assist those persons and organizations who were interested in changing to metric by working with them—industry associations, unions, government agencies, the Congress, educators, and anyone who wished to get involved. In its 14 years of operation, ANMC has become the industrial private sector's information center and spokesman for metric, through published papers, national meetings, management seminars, and testimony before Congress.

In carrying out its role, ANMC was initially nonadvocate in its stance, and exerted most of its activity in educating its subscribers on the metric system and in telling people about how other countries and many firms had or were making the transition

WEIGHTY MATTERS

Which is heavier, an ounce of lead or an ounce of gold?

Which is heavier, a pound of lead or a pound of gold?

These are not trick questions. The ounce of gold weighs more than the ounce of lead, but the pound of lead weighs more than the pound of gold.

The reason is that lead is weighed in the Avoirdupois system, and the gold is weighed in the Troy system. Since there are only 12 ounces in a Troy pound, as compared to 16 in the Avoirdupois, the Troy ounce of gold weighs more than the Avoirdupois ounce of lead.

successfully. As these tasks were completed, ANMC's role has changed so that it now advocates an efficient, orderly transition. It still believes that mandating the change by some form of government action is inappropriate.

In 1975, Congress authorized the creation of the U.S. Metric Board (USMB), but it did not become operative until 1977. The USMB did much good work, but, reportedly because of disagreement among members as to their proper role, President Reagan decided to no longer ask for money to fund the Board. Many of its functions were transferred to the Office of Metric Programs in the Department of Commerce.

In 1978, the General Accounting Office issued a report entitled "Getting a Better Understanding of the Metric System—Implications if Adopted by the United States," and an executive summary. If one reads the lengthy report, the impression is fairly balanced—that the transition to metric was both good and bad, and that there were some problems with the change. The executive summary, however, gave a very negative impression, and that was what some persons read. The paragraph headings in the summary were even more negative, and this is what most people heard because these headings were most often quoted in the press.

The public perception then became that the metric transition was not really occurring. Supporting this concept was the fact that little was actually happening in the consumer area, the one the public had the most contact with. Furthermore, the USMB had been inactivated; and there were the negative newspaper accounts of the General Accounting Office report.

WHAT MIGHT HAVE BEEN DONE

In looking over the last dozen years of metric transition with the clear vision of hindsight, one is challenged to answer the question: What should have been done differently? There seem to be several answers.

Conversion Considered a Technical Matter

The metric system of measurement is certainly technical in nature. But the process of changing from one measurement system to another is a management matter. It involves looking at alternatives, making plans, reaching decisions, training people, selling the idea. The impetus for the conversion came from the standards people, the American National Standards Institute. They should not be criticized for this, but rather complimented.

However, the managements of many firms must have said to themselves: "We better find ourselves a Metric Expert or Coordinator and take care of this matter." They found this individual and usually fitted him into the engineering or manufacturing structure of their firm, at a rather low level so he never was permitted to talk directly to upper management. Thus top management did not understand its critical role in making sure that a workable metric conversion policy was developed for the peculiar requirements of their firm and, most importantly, subsequently followed whenever possible. In many instances, the Metric Coordinator was not able to do his job, or worse, was ignored or even opposed. Of course, there were exceptions—note the auto industry where the direction came from the very top.

We Incorrectly Followed Other Countries Leads

Since the United States is the last country to convert to SI Metric, it was natural to visit other countries to see how they handled the matter. Most set up government commissions, with sector committees made up of representatives from industry, government, consumers, etc., but with funding and direction from government. In most other countries, the standards development is either in government agencies or they are heavily involved.

This is not the case in the United States. Standards are developed by several hundred technical groups, like the ASME, ASTM, and IEEE. Government involvement is generally limited to having appropriate government reps on the committees of these trade associations who are working on standards, each for its particular industry. This committee system works well in America for developing these standards which, by consensus, those involved agree need to be written. But the system doesn't have the drive existing in other countries to see that a conversion or transition of America's measurement system gets done.

Absence of a Forcing Function

Absence of a forcing function is another way of looking at following other countries' leads. Almost the only incentive for anyone to move towards a new measurement system in the United States seems to be the economic one. This means either getting more business, or not losing some of what now exists to foreign competitors. When CEOs of major firms were asked why they weren't moving to metric, they replied: "What additional business will it get me?" In most cases that was difficult to answer and prove.

Metric Transition

Congress has, correctly most people believe, decided not to "mandate" the change to metric. However, Congress's lack of encouragement to change, or to set a target date for completion, has had the effect of giving the impression that Congress was not "for" the change.

Another forcing function is the need of the military. Under NATO, the various member countries are endeavoring to have a world standard for equipment items to improve interchangeability, to increase the number of sources, and to lower unit costs by having fewer items and greater production runs for those items procured. DOD is making considerable progress in speeding up its conversion in selected weapons systems.

Metric Conversion Is a Non-Event

Compared to all the other problems facing the typical CEO, the change of our measurement system must rank very low on his list of concerns. Since there is little chance of its being mandated by government, there is no compelling reason for him to get involved, other than the economic one.

Defective Legislation

Because of pressure from some groups, the Metric Act of 1975 had no teeth in it, no goal or target date for completion, little encouragement for the private sector to really get with it. The Act did set up a 17-member Metric Board, but qualifications were only that the members were to represent a specific sector of business or society.

As a consequence of the ambiguity in the Law, the Metric Board did not have a clear legislative mandate and the Board members, who held very different views, couldn't agree on the Board's mission. Instead of providing clear direction for our transition to metric, the Board confused the issue through constant debate on policy resulting from the incompatible ideologies of its members.

Should business representatives have argued for a better law? They should have tried, but there is doubt that there was much chance for success. Business forces were not in agreement, they were not working from past experience, there was threat, and there was not a large number of them interested in getting involved. Big organizations, like the U.S. Chamber of Commerce and the National Association of Manufacturers, preferred not to participate. About the most that could have been accomplished was (1) setting a higher level of qualifications for members of the Board and (2) putting some encouragement into the law to get the job done expeditiously with a specified target date for completion.

Transition As a Worldwide Activity

Although most nations have been using metric

METRIC MATTERS – MORE INFORMATION

For readers interested in more information about the metric transition, the following three items may be obtained by circling the appropriate numbers on the Reader Service Card bound into this issue.

Metric Handbook for Federal Officials is a 44-page document that contains recommendations for introduction of metric units in proposed legislation, regulations, data requests, and other government use of measurement units. The recommendations were developed for the Interagency Committee on Metric Policy by its working arm, the Metrication Operating Committee, and its Metric Practice & Preferred Units Subcommittee. The document contains a copy of the Metric Conversion Act of 1975. An appendix lists additional references.

Circle no. 101

A Brief History of Measurement Systems is a 4-page publication that opens into a poster that graphically illustrates the modernized metric system. The text describes the English and the Metric systems. The poster is divided into nine segments dealing with measurements of length (meter), time (second), electric current (ampere), luminous intensity (candela), temperature (Kelvin), plane angle (rad), solid angle (steradian), mass (kilogram), and amount of substance (mole).

Circle no. 102

Information on the American National Metric Council is divided into three parts. The first asks and answers such questions as "Who is using metric today?" and "What are the cost savings associated with metric transition?" The second part describes the Council and its activities. It lists and describes the Council's programs and publications. The third part of this literature gives a detailed list of "Programs You Can Support," including regional workshops. This part of the *Information* booklet is open-ended in that there is a coupon that can be filled out for additional data about "Information & Services" and "Support & Visibility."

Circle no. 103

measurement for years, they have not all been using the same, uniform, standardized system. In 1960, a General Conference adopted a revised and simplified system that has been given the international abbreviation "SI." All countries are moving toward complete usage of SI. In the United States, this means replacement of the present English system. In metric nations, it also means transition. They must get nonstandard SI units out of their day-to-day usage. Germany and Belgium, although metric, were only 90 percent SI in the late '70s. They anticipated one or two generations to achieve 100 percent SI. Some measurement experts and educators have said that the job of converting in the United States will be easier than the Europeans' task of cleaning up an existing system.

WHAT'S HAPPENING NOW

1. DOD is moving rapidly to get its metric standards in place. Increased procurement in metric products is occurring.
2. The aerospace sector has picked up significant speed in its conversion.
3. The ANMC is concentrating its activities in Task Forces to help solve "across-industry" problems in measurement-sensitive areas, such as transportation of lightweight products, metric building codes, and export sales of all products.
4. To answer the question: "How much more export business would the USA get if it had a full line of metric products?" or, even more importantly, "How much are we losing because we are not 100 percent metric capable?", Congress is considering asking the Office of Technology Assessment to investigate this matter, concentrating the study in the areas of machinery and materials (both raw and finished), with the interests of both large and small business included.

Metric Transition

5. The understanding and cooperation between government and private agencies interested in completing metric transition is at a very high level. This includes Congress and its staff members, the Administration and its many agencies, and business organizations representing both large and small firms.

Much has been accomplished if one examines what has occurred in the area of metric transition over the past 15 years, considering there was no past experience or history for guidance. Much was done right. Industries are either converted, are well on their way, or are educated and positioned to move when the time is ripe. Changing the measurement system for a country with the world's largest economy is no small task. Many say that taking a generation or so is doing it in a rather expeditious time.

When will the transition be completed? Within 5 to 10 years, most things will be metric. Some will be hybrid. Some will be soft-converted. But as long as football is played, it will always be: "First down and 10 yards to go."

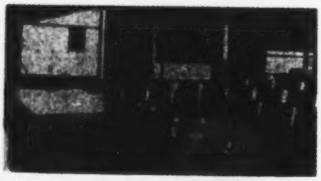
– G. D. Meixel

GEORGE D. MEIXEL, while manager of Ingersoll-Rand's Corporate Office in Washington, D.C., was associated with the American National Metric Council, serving on its Board of Directors for many years, including three as chairman. ☐

LIFE WITHOUT DINOSAURS

Much is being written about metrics, both pro and con. One article in the *National Geographic* made the following statement that makes one pause and think:

"Despite claims to the contrary, the dinosaurs did not go away overnight, nor will the older standards. The world has learned to live without dinosaurs. In time we'll all learn to live with metric."



Corporate giving.
Without it, a lot of important things might go out of business.

A lot of organizations in a lot of different fields could barely exist without help from corporations.

To their credit, a great many companies realize this.

Every year for the past ten years, corporate giving has gone up. And that's something the entire corporate community can take pride in.

There are so many ways a corporation can give. So many ways to lend a hand.

The fact is, when corporate giving thrives, so do the organizations it supports.

And everyone profits.

Lend a hand

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Mr. **DeSimone**. Well, I think—I really think that the basic problem here is that every sector of society does not know to whose drum this process is marching. There is not a national policy that at a certain time, the metric system shall be the predominant system for use in the United States, not the exclusive one. There is a great deal of doubt about who is doing what and how do you coordinate all of this. I think part of the problem in all of this is that there are zealots on both sides of the question. The notion that we are going to change everything in our society to conform to the international system of units, turns off many people who are otherwise favorably disposed to a metric changeover. On the other extreme are those who feel, as I indicated in my testimony, that we haven't seen the end of this yet, that really it is conceivable that the rest of the world will come back to the customary system of measurement.

I do think, Mr. Chairman, that it would be useful to get this into the debate on the trade bill—the notion that doing what this bill H.R. 1964 proposes is a step in the right direction. It will help. It will not solve the trade problem obviously, but every little bit helps. When we demand that Japan and other countries open their markets to us, we're demanding that they open a metric market to us in which all the people in business and commerce and Government think and trade in metric terms. Well, I think that this fact ought to be entered into the debate on the trade bill as one way, one additional way in which we positively can help ourselves. Obviously, there's a great deal of debate on all the negative factors. That is, what can we do to protect our own market. We ought to be thinking about, what can we do to encourage our industry to perform better in the metric markets which are throughout the world.

Mr. **Feigin**. Let me just say a few words.

The electronics industry, worldwide, has been going metric. At the present time, Digital Equipment Corp. has been converting over at a rather slow rate. Some of our competition has completely converted over to full metric. At the present time——

Mr. **Ritter**. Where's IBM?

Mr. **Feigin**. IBM is fully metric.

Mr. **Ritter**. It's fully metric?

Mr. **Feigin**. Yes.

Mr. **Ritter**. Where's AT&T?

Mr. **Feigin**. I don't know. I have no information as to what their position is. I do have information on certain other companies, but that is one I have no information on.

It turns out that the products we are building fall into either fully metric or partially metric. The equipment purchased in the Far East is, for the most part, all metric. Our pieces of equipment produced in Europe fall into the business of either being all metric or partially metric. Even much of our internal domestic manufacture is partly metric.

In my paper, I indicated the business on certain connectors. It turns out there are standards in the industry today for AC power. This is one of the most highly regulated areas in the world today. It turns out, for interconnection purposes, the Europeans have agreed, and the Americans are also signed off on it, by the way, for various interface connectors. In other words, between the country's power systems and our equipment. All those standards are metric. So, any of those particular pieces and parts that you will find on your equipment in your office or in your home, you will find them fully metric. And that goes across the board.

Mr. Ritter. But, is it necessary as they will point out in this article, is it necessary for local and regional companies to go metric. They don't export anyway, and as they say in the article—I'm just playing devil's advocate for a minute—and exports are only 10 percent and if we could really do a fantastic job, maybe we could double that so we're at 20 percent.

Mr. Feigin. Well, I'll answer the question with a little story.

It turns out I pushed on a particular product to meet the particular requirements of a specific country. And, they pointed out to me that they really didn't have many sales in that particular country, so why should they exert themselves to make this product work in that country. I said, I can't understand how you sold any there. It doesn't speak their language, and it doesn't work on their power system. So, I mean whoever bought it there didn't know what they were doing anyway. So, this business of we're not exporting much, is a problem. You can't export if you can't use the product there. You run into the other problem that we have, which people say to me, can we ship to a particular country. Well, you can ship to that country, but it's not legal to turn the equipment on. So, I mean, who would buy it. So, you know, it's a chicken and egg situation.

Mr. DeSimone. There's another aspect to that too, Congressman Ritter. And that is that small businesses that may not themselves export to foreign countries, are suppliers to major companies within the United States, and these companies, such as IBM and Digital Equipment are converting, or are fully converted. They want suppliers that can conform to their measurement system and their standards. So, it's important for small businesses, even that operate exclusively in the United States to consider the implications.

Mr. Ritter. Just think, if we didn't have a standard for voltage and that our appliances didn't know what voltage they would see when you plugged them in, think of the chaos that that would create and I think we have a——

Mr. Feigin. That, by the way, is why the people such as the Japanese have targeted the United States, because you have all of North America on one voltage system. In the world today, you have perhaps five or six different normal voltages that you have to operate——

Mr. DeSimone. And frequencies.

Mr. Feigin. There are two frequencies, 50 and 60. Japan runs on 100 and 200, North America runs on 120, Central Europe runs on 220, England, Ireland and Australia run on 240 and Israel and New Zealand run on 230. It is havoc out there.

Mr. DeSimone. May I add one other point on the question that you raised, Mr. Brown, about the trade bill and the debate?

There's an area that is probably not appreciated, and that is international standards activities. In the International Standards Organization, as you know, Mr. Chairman, having been behind many of these proposals for reform, the standards for world commerce are largely set. The countries that are most competitive on the world scene, Japan, West Germany and so on, have very, very active international standards activities in Geneva. They are supported by their Governments. It is not true of the United States. It's incredible, but we do not have official and tangible government support for international standards activities that would be in the best interests of this country.

Mr. FEIGIN. That's very true.

Mr. BROWN. Any further questions Mr. Ritter?

Mr. RITTER. I have no further questions. Thank you.

Mr. BROWN. Gentlemen, we're running up against a time pressure. I'm going to ask that if we have further questions from the staff or committee members, that we address them to you in writing, and hopefully you'll be good enough to respond to them. We do very much appreciate your presentations this morning. I hope that the committee will act favorably and quickly on this legislation and then the hard part comes, moving it through the rest of the process and getting it signed into law.

Thank you very much and the committee will be adjourned to reconvene again tomorrow, April 29, at 9:30 a.m.

[Whereupon, at 12:15 p.m., the subcommittee recessed, to reconvene at 9:30 a.m., Wednesday, April 29, 1987.]

THE ROLE OF SCIENCE AND TECHNOLOGY IN COMPETITIVENESS

WEDNESDAY, APRIL 29, 1987

House of Representatives,
Committee on Science, Space, and Technology,
Subcommittee on Science, Research and Technology,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:45 a.m., in room 2325, Rayburn House Office Building, Hon. Doug Walgren (chairman of the subcommittee) presiding.

Staff present: Jim Turner, subcommittee counsel; Carol Pompliano, professional staff; David Goldston, professional staff; Carolyn Radabaugh, professional staff; Grace Ostenso, subcommittee staff director.

Mr. Walgren. Let me call the subcommittee meeting to order.

Today is the second day of hearings held by our Science, Research and Technology Subcommittee on the role of science and technology in competitiveness. The focus today will be on the Administration's competitiveness initiative, along with two bills introduced by Congressman Brown and another bill that has been introduced by Congressman Valentine. Our first witness, Douglas Riggs, the General Counsel of the Department of Commerce, is well-versed on the Administration proposals as they affect the Department of Commerce, ranging from technology transfer to foreign technical literature to antitrust reform. He is here to talk with us about the scope and the intent of the recent Executive Order on technology transfer and to present the Administration's position on a number of other portions of H.R. 115, the Administration's trade initiative.

Mr. Riggs will be followed by a panel of witnesses who will discuss H.R. 2164, which would create a Department of Science and Technology, and H.R. 2165, which would create a National Policy and Technology Foundation. These bills, which provide alternate solutions to the problems we have in finding a focal point within the Government for funding applied research in support of industries, were both authored by Mr. Brown of California.

The final panel will then talk with us about the problems of the semiconductor industry in relationship to these bills. The witnesses also will be asked to give their views on a bill by Mr. Valentine which would provide a focus for government efforts related to the semiconductor industry by creating a National Advisory Commission on Semiconductors.

[The prepared opening statements of Congressman Boehlert and Congressman Brown follow:]

HON. SHERWOOD BOEHLERT (R-NY)
OPENING STATEMENT
COMPETITIVENESS HEARINGS
APRIL 29, 1987

MR. CHAIRMAN:

ON THIS SECOND DAY OF OUR COMPETITIVENESS HEARINGS, WE HAVE A CHANCE TO EXAMINE IN DETAIL THE SITUATION OF ONE INDUSTRY THAT HAS BEEN BATTERED BY FOREIGN COMPETITION -- SEMICONDUCTORS.

THIS CASE STUDY WILL ENABLE US TO PURSUE THE QUESTIONS WE BEGAN TO EXPLORE YESTERDAY: WHAT FACTORS ARE RESPONSIBLE FOR THE POOR COMPETITIVE POSITION OF SOME OF OUR MOST IMPORTANT INDUSTRIES? WHAT SHOULD THOSE INDUSTRIES BE DOING TO RESTORE THEIR VIABILITY? HOW CAN FEDERAL AND STATE GOVERNMENTS HELP? DOES THE FEDERAL GOVERNMENT NEED NEW ORGANIZATIONS OR NEW PROGRAMS TO HELP REVIVE INDUSTRY? HOW CAN NEW TECHNOLOGY HELP INDUSTRY PROSPER AND HOW SHOULD IT BE DEVELOPED?

THE ANSWERS TO OUR QUESTIONS WILL NOT JUST HELP US DECIDE HOW TO MAINTAIN A HEALTHY SEMICONDUCTOR INDUSTRY. THEY SHOULD HELP BUSINESSES AND THE GOVERNMENT PREVENT OTHER INDUSTRIES FROM FALLING PREY TO THE SAME FORCES.

THANK YOU.

HON SHERWOOD BOEHLERT
OPENING STATEMENT
HEARINGS ON COMPETITIVENESS
APRIL 28, 1987

MR. CHAIRMAN:

THE HEARINGS WE BEGIN TODAY REALLY FOCUS ON TWO ESSENTIAL QUESTIONS: HOW CAN WE ENSURE THAT THE GOVERNMENT SPONSORS RESEARCH THAT INDUSTRY CAN USE, AND HOW CAN WE ENSURE THAT INDUSTRY DOES USE THAT RESEARCH?

THE BILLS BEFORE US THIS WEEK -- INCLUDING MINE -- ANSWER THOSE QUESTIONS WITH NEW GOVERNMENT ORGANIZATIONS AND NEW GOVERNMENT PROGRAMS. I THINK THAT THROUGHOUT THESE HEARINGS WE SHOULD REGARD SUCH ANSWERS WITH A HEALTHY SKEPTICISM. THE GOVERNMENT CAN AND SHOULD DO MORE, BUT MUCH OF WHAT NEEDS TO BE DONE NOW, CAN AND SHOULD BE DONE BY INDUSTRY.

A LOOK AT OUR CHIEF COMPETITOR IS INSTRUCTIVE. JAPAN, AS WE ALL KNOW, HAS GROWN WEALTHY BY ADOPTING THE RESULTS OF AMERICAN RESEARCH. THE JAPANESE HAVE NOW TAKEN THE LOGICAL NEXT STEP AND ARE, IN EFFECT, TURNING OUR UNIVERSITIES INTO "SURROGATE MOTHERS." JAPANESE FIRMS PROVIDE THE "SEED MONEY" FOR RESEARCH, AND THEN AFTER THE GESTATION PERIOD WHEN THE RESEARCH IS USABLE, OUR RESEARCHERS TURN IT BACK TO THE JAPANESE TO DEVELOP AND TAKE AROUND THE WORLD. THE JAPANESE, APPARENTLY, THINK OUR RESEARCH IS NEITHER INSUFFICIENTLY TARGETED NOR INACCESSIBLE.

WHY DON'T AMERICAN FIRMS MAKE EQUAL USE OF OUR RESEARCH? IT'S HARD TO KNOW. DO WE NEED ADDITIONAL PROGRAMS TO COAX UNIVERSITIES AND INDUSTRY TO GET TOGETHER? PERHAPS WE DO. BUT BEFORE WE REPLACE ADAM SMITH'S INVISIBLE HAND WITH UNCLE SAM'S OUTSTRETCHED ONE, WE'D BEST BE SURE INCREASED COMPETITIVENESS WILL BE THE RESULT.

WE'VE ALREADY TAKEN SOME IMPORTANT STEPS TOWARD INCREASING COMPETITIVENESS THROUGH COOPERATION. THE NATIONAL SCIENCE FOUNDATION'S ENGINEERING RESEARCH CENTERS AND THE TECHNOLOGY TRANSFER ACT -- BOTH CHAMPIONED BY THIS SUBCOMMITTEE -- ARE PRIME EXAMPLES.

THE STATES -- WHICH ARE THE GOVERNMENT'S POLITICAL SCIENCE LABORATORIES -- HAVE ALSO CREATED INNOVATIVE PROGRAMS TO PROMOTE TECHNOLOGY TRANSFER. BOTH CONGRESSWOMAN SCHNEIDER AND I PLAN TO INTRODUCE BILLS THAT WOULD BUILD ON THOSE PROGRAMS.

SO THE QUESTION IS NOT WHETHER GOVERNMENT HAS A ROLE, BUT WHETHER THAT ROLE NEEDS TO BE EXPANDED. SHOULD THE GOVERNMENT, FOR EXAMPLE, BE IN THE BUSINESS OF FINANCING COMMERCIALIZATION OF PRODUCTS OR PROCESSES? WILL FIRMS, PARTICULARLY SMALL ONES, BE UNINTERESTED IN USING NEW

TECHNOLOGY IF THE GOVERNMENT DOESN'T HAND IT TO THEM ON A SILVER PLATTER? I'M NOT SURE SENATOR HOLLINGS AND I WOULD ANSWER THESE QUESTIONS THE SAME WAY.

SIMILARLY, GIVEN THE CURRENT GOVERNMENT-WIDE CONCERN, EVEN OBSESSION, WITH COMPETITIVENESS, I'M NOT SURE HOW MUCH REORGANIZATION WOULD ACCOMPLISH. AS PUBLIC OFFICIALS, WE DON'T LIKE TO BELIEVE THERE ARE PROBLEMS BEYOND OUR CONTROL, BUT IT MAY BE THAT CORPORATE RATHER THAN GOVERNMENT RESTRUCTURING IS THE MORE URGENT NEED.

BEFORE WE CREATE TOO MANY NEW PROGRAMS, WE OUGHT TO BE SURE OUR EXISTING RESEARCH AND EDUCATION PROGRAMS ARE FUNDED ADEQUATELY -- THEY AREN'T.

WHEN ASSISTANT SECRETARY PERLE TESTIFIED HERE LAST WEEK, HE DERIDED "COMPETITIVENESS" AS A "SLOGAN MASQUERADING AS A POLICY." WE OUGHT TO APPROACH OUR ASSIGNMENT THIS WEEK WITH SOME HUMILITY AND SOME SKEPTICISM, LEST WE DO SOMETHING THAT PROVES MR. PERLE CORRECT.

THANK YOU.

REMARKS OF CONGRESSMAN GEORGE E. BROWN, JR.

APRIL 29, 1987

BEFORE THE SUBCOMMITTEE ON

SCIENCE, RESEARCH, AND TECHNOLOGY

I welcome our witnesses on this second day of hearings on Competitiveness.

The decline in industrial competitiveness in the US has been slow in coming, evolving as it has for four decades. With this problem now at such advanced stages, it is unrealistic for this committee or Congress to assume that the solution will come quickly or painlessly. The public and private sector must be equal partners in finding the answer to regaining American economic strenth.

Through the efforts of Congress and the Administration, hopefully, a national effort can be mounted to enable U.S. industry to improve its productivity, manufacturing techniques, and product quality.

In a sense we have won half the battle. The country is finally coming to terms with the enormous trade imbalance and decline of the U.S. ability to compete with foriegn manufacturers at home or abroad. With the nation now focused on this problem, perhaps now we can begin to take the action to reverse the decline.

Of course the discussion of the competitiveness encompasses a broad range of issues involved in business practices, from market evaluation, to product development, productivity, and management policies. In the Science Research and Technology Subcommittee, we are focusing on the technology base in industry, and the extent to which U.S. industry takes full advantage of the technologies available.

A National Acadamy of Sciences conference reported that the Japanese manufacturing worker is backed up by $48,000 in technology and capitol investment; in the United States, the comparable figure is only $32,000. In order to bring our industrial plant and equipment up to the level of the Japanese, it would require an increase investment over some reasonable time period of about $320 billion for our 20 million manufacturing workers. There is clearly a huge gap between American and Japanese commitment to their industrial base.

Although the public and private sector have a joint responsibility in transferring and fostering improved technology utilization in American factories and shops, I believe the federal government must have the clear role of providing the focus. Although we have extremely capable agencies such as the National Bureau of Standards, efforts must be broadly expanded.

Many of my colleagues agree that there should be a coordinated national effort to address the issue of science and technology policies on a continuous basis and we must find ways to integrate science and technology policy with economic and investment policy. I have introduced a number of bills over the years which address would establish a coordinated public effort to provide technical information and support to the enhance the technology transfer into industry.

The bills that are being considered in these three days of hearing represent a solid base of material for discussion. I look forward to the outcome and fully expect that they will add to the solution America's competitive shortfall.

Mr. **Walgren**. We welcome you all to the committee and appreciate your developing the presentations that you will make to us. Written statements will be made a part of the record in full so in presenting your testimony, know that you can feel free to focus on parts of it or underscore in whatever way you see fit the best points that you want to bring out.

With that, let me welcome Douglas Riggs, the General Counsel of the Department of Commerce.

Welcome to the committee, Mr. Riggs.

STATEMENT OF DOUGLAS RIGGS, GENERAL COUNSEL, DEPARTMENT OF COMMERCE

Mr. **Riggs**. Mr. Chairman, thank you very much.

Before I begin my presentation, I would ask your indulgence that I might have a point of personal privilege. I would like to acknowledge that there are a number of employees, public servants from the Department of Commerce that are here today, and in particular I would like to acknowledge Bob Ellert, who is the Chief Counsel for Economic Affairs, and Norm Latker, who heads the Office of Federal Technology Management in OPTI.

These are two career individuals who have been in the trenches and working very diligently in promoting these ideas that your committee are discussing. They have been very active in helping to bring about the policies which I think we all applaud, which we all encourage, and which we all hope will result in a better competitive environment for the American business community.

Mr. Chairman, I want to thank you for inviting the Department of Commerce this morning to allow us to participate with you. I want to assure you that this issue that we are discussing is an issue of immense importance to both Secretary Baldrige as well as Deputy Secretary Brown, and we are particularly pleased that you asked us to discuss the impact of the President's recent Executive Order on access to federally funded research and development.

Its impact on American competitiveness can be summed up very succinctly: It will be direct and substantial. The President's order should be viewed as a critical part of a comprehensive series of proposals and actions to enhance productivity, to foster innovation, and to improve our standard of living. The President's competitiveness initiative includes proposals designed to: one, obtain excellence in education; two, generate new knowledge and advanced technologies; three, expand the nation's talent base in science and technology; four, protect business from unfair foreign competition; and five, increase the protection we give to those who create, those who take risks in bringing those creations to the marketplace.

It is the last aspect that is particularly relevant this morning. While the President's intellectual property proposals are very much concerned with strengthening the protection afforded to intellectual property—that is, the incentives to invent and the talent base of scientists and engineers, that is, the ability to invent—attention must also be paid to how well we manage what we invent.

Our intellectual property system is one of the finest in the world, and it clearly provides incentives. The talents of the American people are unmatched, and they clearly have the ability. Unfortunately, the management record in the private as well as the public sector has not always been as good as it could have been.

For example, the record shows clearly that many firms in the private sector, in their effort to do business on a global scale, were not always as careful as they could have been in structuring their joint ventures, licensing agreements and marketing, manufacturing or supply arrangements. As a result, foreign firms in such fields as consumer electronics often emerged as the principal beneficiaries in technology financed and developed by American companies. We are starting to see signs that American firms are being a lot more careful about protecting their interests.

The public sector is also starting to manage what it produces better. Here the main problem has been that too much of what we do develop as a result of our $55 billion annual Federal investment in research and development stays on the shelf and never gets commercialized. Why should this be? It is not an oversimplification to say that line managers, that is, those who do the work of the Federal scientific establishment, have just not had the direction and the incentives to do what needs to be done.

The President's Executive Order addresses these problems head on. Its various provisions, some of which I will discuss in detail in a moment, all point in this direction: Keep the lines of international scientific communication open but never forget that: one, the Federal investment in R&D can lead to new products, new jobs and new industries; and two, that the first to stake a claim to these benefits should be American industry.

Let me then turn to the order itself. Three of its themes are: incentives, decentralization, and effective international cooperation. Let me turn to each of these.

First, the President reaffirmed the fundamental principle that if you expect people to invent something, figure out whether it has any commercial applications, and if so, get it to the marketplace. You had better let them profit from it.

Several aspects of the President's order demonstrate this concept and principle. First, the President elevated his 1983 Memorandum to Agency Heads to an Executive Order status. What this means is that the Order, together with Public Laws 96-517, 98-620 gives universities, small businesses and, to the extent permitted by law, all other contractors the first right of ownership to inventions made with Federal funds.

This profit motive gives these contractors incentives to report new inventions, thus adding to the store of scientific and technical knowledge and to develop and exploit their commercial potential.

Second, the Executive Order calls for the immediate implementation of the Technology Transfer Act of 1986, which permits Government-owned, Government-operated, or GOGO labs, to enter into cooperative R&D arrangements that allow the federally employed inventor at these labs and the lab itself to share in the royalty stream from resulting inventions.

In fact, the President's Order called for prompt implementation of the act's provisions concerning royalty sharing and cash awards.

The second basic theme of the Executive Order is decentralization. That is, keep the ownership of the technology in the hands of the Federal contractors who created it, for they are the ones who understand it the most and are the best able to appreciate its commercial potential. Placing control in the hands of universities, small businesses and other contractors ensures the complex decisions as to whether a new technology should be published, patented, copyrighted or trademarked or held in abeyance would be made by persons with the proper background to judge its value.

The President's Order extended this principle to the Government-owned, Government-operated labs as well. His Order directed agency heads to delegate to the lab directors themselves the authority to enter into cooperative R&D agreements as well as the authority to license resulting inventions. This will give the lab director the ability to give ownership or control of inventions to those in the private sector who are best able to commercialize them.

In other words, the President's Order reflects the principle established by the earlier statute and his 1983 memorandum. The people who create technology are the ones best able to manage it.

A third major feature of the Order relates to international cooperation. Our openness as a society contributes greatly to international scientific progress, but as the President's Order clearly reflects, other nations have obligations of their own and we have the right to expect them to live up to them.

For this reason, we are very pleased that the President directed agencies entering into cooperative agreements with foreign governments to consider whether they protect intellectual property and are willing to include our citizens and public agencies in cooperative research and licensing arrangements.

Between the President's express instruction and the fact that we have now in place a comprehensive series of statutes and orders that give labs strong financial incentives to control the technology they produce, we are confident that the goal of transferring federally financed technology to the marketplace where it can generate new businesses and new jobs will be achieved.

I want to assure you that the Department of Commerce will do all that it can to implement these goals. We have a number of responsibilities under the Technology Transfer Act. These include providing technical assistance to other Federal agencies, helping them evaluate the commercial potential of inventions, developing a model cooperative agreement on R&D, and keeping the President and the Congress informed as to the progress the government is making in transferring technology to the private sector.

We take these duties very seriously and we are moving swiftly to execute on them.

Secretary Baldrige has formally vested his authority in the Act in our Under Secretary for Economic Affairs, Dr. Robert Ortner. Bob has already established an interdepartmental committee to assist him. This will enable him to take full advantage of the Department's scientific, technical and management experience.

Our Assistant Secretary for Productivity, Technology and Innovation will be represented, as will be NBS, NOAA, NTIA, as well as my own shop, the General Counsel's Office. To ensure that we get valuable input from elsewhere in the government, Secretary Baldrige is establishing an interagency committee. It will give us valuable insight as to how we can best make our expertise available for evaluating the commercial potential of inventions and the various commercialization options available to labs.

As provided by the act, our National Bureau of Standards has agreed to house the new Federal Laboratory Consortium on a reimbursable basis, and the Secretary has written to other agency heads asking them for appropriate funding. In addition, I am pleased to note that last month OMB approved our final rule on patent rights to inventions made by non-profit organizations and small business firms. That final rule was published in the Federal Register on March 18th.

There are a number of other important features in the order. I will mention them only briefly because it is too soon to know precisely what direction they will take and because there is another element of the President's competitive initiative I want to discuss which has a very direct and important bearing on how we transfer technology from the inventor to the marketplace.

These other features of the order include: one, an instruction to agencies to try to develop a policy for allowing contractors to retain ownership of federally funded technical data to parallel the current policy regarding ownership of patent rights, and two, and instruction to specified agencies to cooperate in developing a technology share program with U.S. industries and universities.

The final point is a direction to agency heads to consider the potential for establishing basic science and technology centers at universities.

As I noted a moment ago, I would like to conclude by mentioning one other aspect of the President's proposals that I believe will have great impact on how technology gets transferred. The various bills I mentioned all recognize a basic truth: the inventor is not always the one who has the skill, interest or resources to commercialize an invention. That often depends on his or her ability to assign or license the patent to those who can fully develop its commercial potential.

Whether we are talking about Federal labs or private ones, a favorable climate for licensing is essential if inventions are to be commercialized. Unfortunately, many courts see patents as monopolies that conflict with the laws and have severely limited the patentee's ability to work out satisfactory licensing arrangements. Many courts will automatically condemn certain arrangements as per se violations of the antitrust laws without considering their pro-competitive potential.

The President suggested a number of proposals to improve the climate for patent licensing. The Judiciary Committee on the House side will hold hearings tomorrow on these issues. I believe that this committee, however, has a very real stake in the outcome of those deliberations.

In sum, Mr. Chairman, we believe the President has devised a comprehensive and workable plan for converting taxpayer-financed research into new products, new jobs, and improved living standards for all of us. His plan is fiscally responsible and relies in large part, and appropriately so, on the profit motive and on letting the right people manage the technology.

Again, Mr. Chairman, on behalf of the Department of Commerce, we appreciate the opportunity to be here, to respond to any inquiries that you might have, and if there are any inquiries that we are not responsive on today, you can rest assured that we will in the future.

[The prepared statement of Douglas Riggs follows:]

STATEMENT OF DOUGLAS A. RIGGS, GENERAL COUNSEL OF THE U.S. DEPARTMENT OF COMMERCE, ON ACCESS TO FEDERALLY FUNDED SCIENCE AND TECHNOLOGY

Mr. Chairman, on behalf of Secretary Baldrige and Deputy Secretary Brown, I want to thank you for inviting the Department of Commerce to participate in this very important series of hearings on competitiveness. This is an issue that Secretary Baldrige and Deputy Secretary Brown care about very deeply and I know they both regret their inability to be here.

We are particularly pleased that you asked us to discuss the impact of the President's recent Executive Order on access to federally funded research and development. Its impact on American competitiveness can be summed up very succinctly: it will be direct and substantial.

The President's Order should be viewed as a critical part of a comprehensive series of proposals and actions to enhance productivity, to foster innovation, and to improve our standard of living. The President's Competitiveness Initiative includes proposals designed to:

One, obtain excellence in education,

Two, generate new knowledge in advanced technologies,

Three, expand the nation's talent base in science and technology,

Four, protect business from unfair foreign competition, and

Five, increase the protection we give to those who create and those who take risks in bringing those creations to the marketplace.

It is the last aspect that is particularly relevant this morning. While the President's intellectual property proposals are very much concerned with strengthening the protection afforded to intellectual property—that is, the incentives to invent—and the talent base of scientists and engineers—that is, the ability to invent—attention must also be paid to how well we manage what we invent.

Our intellectual property system is one of the finest in the world and clearly provides incentives. The talents of the American people are unmatched and they clearly have the ability. Unfortunately, the managmement record—in the private as well as the public sector—has not always been as good as it could have been.

For example, the record shows clearly that many firms in the private sector, in their effort to do business on a global scale, were not always as careful as they could have been in structuring their joint ventures, licensing agreements, and marketing, manufacturing or supply arrangements. As a result foreign firms in such fields as consumer electronics often emerged as the principal beneficiaries in technology financed and developed by American companies. We are starting to see signs that American firms are being a lot more careful about protecting their interests.

The public sector is also starting to manage what it produces better. Here the main problem has been that too much of what we do develop as the result of our $55 billion annual federal investment in research and development stays on the shelf and never gets commercialized.

Why should this be? It is not an oversimplification to say that line managers—that is, those who do the work—of the federal scientific establishment have just not had the direction and the incentives to do what needs to be done. The President's Executive Order addresses those problems head on. Its various provisions, some of which I will discuss in detail in a moment, all point in this direction: Keep the lines of international scientific communication open but never forget that (one) the federal investment in R&D can lead to new products, new jobs, and new industries, and (two) that the first to stake a claim to these benefits should be American industry.

Let me, then, turn to the Order itself. Three of its themes are: incentives, decentralization, and effective international cooperation. Let me turn to each of these.

First, the President reaffirmed the fundamental principal that if you expect people to invent something, figure out whether it has any commercial applications, and, if so, get it to the market-place, you had better let them profit from it. Several aspects of the President's order demonstrates this concept and principal.

First, the President elevated his 1983 memorandum to agency heads to executive order status. What this means is that the order, together with Public Laws 96-517 and 98-620, gives universities, small businesses, and, to the extent permitted by law, all other contractors the first right of ownership to inventions made with federal funds. This profit motive gives these contractors incentives to report new inventions—thus adding to the store of scientific and technical knowledge—and to develop and exploit their commercial potential.

Second, the Executive Order called for the immediate implementation of the Technology Transfer Act of 1986 which permits Government-owned, Government-operated or GOGO labs to enter into cooperative R&D agreements and allows the federally-employed inventor at these labs and the lab itself to share in the royalty stream from resulting inventions. In fact, the President's order called for prompt implementation of the Act's provisions concerning royalty sharing and cash awards.

The second basic theme of the Executive Order is decentralization—that is, keep the ownership of the technology in the hands of the federal contractorss who created it, for they are the ones who understand it the most and are best able to appreciate its commercial potential. Placing control in the hands of universities, small businesses, and other contractors ensures that complex decisions as to whether a new technology should be published, patented, copyrighted, trademarked or held in abeyance would be made by persons with the proper background to judge its value.

The President's Order extended this principal to the government-owned, government-operated labs as well. His order directed agency heads to delegate to the lab directors themselves the authority to enter into cooperative R&D agreements as well as the authority to license resulting inventions. This will give the laboratory director the ability to give ownership or control of inventions to those in the private sector who are best able to commercialize them.

In other words, the President's Order reflects the principal established by the earlier statutes and his 1983 Memorandum: the people who create technology are the ones best able to manage it.

A third major feature of the Order relates to international cooperation. Our openness as a society contributes greately to international scientific progress, but, as the President's order clearly reflects, other nations have obligations of their own and we have the right to expect them to live up to them. For this reason, we were very pleased that the President directed agencies entering into cooperative agreements with foreign governments to consider whether they protect intellectual property and are willing to include our citizens and public agencies in cooperative research and licensing arrangements.

Between the President's express instructions and the fact that we now have in place a comprehensive series of statutes and orders that give labs strong financial incentives to control the technology they produce, we are confident that the goal of tranferring federally financed technology to the marketplace, where it can generate new businesses and new jobs, will be achieved.

I want to assure you that the Department of Commerce will do all it can to make it so. We have a number of responsibilities under the Technology Transfer Act. These include providing technical assistance to other federal agencies, helping them evaluate the commercial potential of inventions developing a model cooperative agreement on R&D, and keeping the President and the Congress informed as to the progress the Government is making in transferring technology to the private sector. We take these duties very seriously and we are moving swiftly to execute on them.

Secretary Baldrige has formally vested his authority under the Act in our Under Secretary for Economic Affairs, Dr. Robert Ortner, and Bob has already established in Intradepartmental Committee to assist him. This will enable him to take full advantage of the Department's scientific, technical and management experience. Our Assistant Secretary for Productivity, Technology and Innovation will be represented as will NBS, NOAA, NTIA, and my own shop, the General Counsel's Office.

To ensure we get valuable input from elsewhere in the Government, Secretary Baldrige is establishing an Interagency Committee. It will give us valuable insight as to how we can best make our expertise available for evaluating the commercial potential of inventions and the various commercialization options available to labs.

As provided by the Act, our National Bureau of Standards has agreed to house the new Federal Laboratory Consortium on a reimbursable basis and the Secretary has written to other agency heads asking them for appropriate funding.

In addition, I am pleased to note that last month OMB approved our Final Rule on Patent Rights to Inventions made by Non-Profit Organizations and Small Business Firms. That final rule was published in the Federal Register on March 18.

There are a number of other important features in the Order. I will mention them only briefly because it is too soon to know precisely what direction they will take and because there is another element of the President's Competitiveness Initiative I want to discuss which has a very direct and important bearing on how we transfer technology from the inventory to the marketplace.

These other features of the Order include:

One, an instruction to agencies to try to develop a policy for allowing contractors to retain ownership of federally funded technical data to parallel the current policy regarding ownership of patent rights;

And two, an instruction to specified agencies to cooperate in developing a Technology Share Program with U.S. industries and universities;

And the final point is a direction to agency heads to consider the potential for establishing basic science and technology centers at universities.

As I noted a moment ago, I would like to conclude by mentioning one other aspect of the President's proposals that I believe will have great impact on how technology gets transferred. The various bills I mentioned all recognize a basic truth: the inventor is not always the one who has the skill, interest, or resources to commercialize an invention. That often depends on his or her ability to assign or license the patent to those who can fully develop its commercial potential. Whether we are talking about federal labs or private ones, a favorable climate for licensing is essential if inventions are to be commercialized.

Unfortunately, many courts see patents as "monopolies" that conflict with the antitrust laws and have severely limited the patentee's ability to work out satisfactory licensing arrangements. Many courts will automatically condemn certain arrangements as per se violations of the antitrust laws without considering their procompetitive potential.

The President suggested a number of proposals to improve the climate for patent licensing. The Judiciary Committee will hold hearings tomorrow on these issues. I believe this Committee has a very real stake in the outcome of those deliberations.

In sum, Mr. Chairman, we believe the President has devised a comprehensive and workable plan for converting taxpayer financed research into new products, new jobs, and an improved living standard. His plan is fiscally responsible and relies in large part, and appropriately so, on the profit motive and on letting the right people manage the technology.

Thank you, Mr. Chairman. I will be pleased to answer any questions you may have.

Mr. WALGREN. Thank you very much, Mr. Riggs, for that statement. We certainly want to encourage the Administration in the directions that are covered by the President's Executive Order.

One of the things that strikes me, though, is that I wonder why it takes so long to get some of these policies translated into actual practice. Correct me if I am wrong, but here we now have OMB, as I understand it, issuing regulations covering patent rights to inventions by non-profit organizations and small business firms.

When did the Congress pass that enabling of patent right retention in those firms?

Mr. RIGGS. 1980 and 1984.

Mr. WALGREN. Didn't we first do small business in earlier years and then later come back and pick up the larger organizations in terms of giving them the standing to retain patent rights?

Mr. RIGGS. As I understand it, Mr. Chairman, the statutes that have been passed have dealt essentially with small businesses and non-profits. It has not dealt explicitly with what I will call large businesses. In fact, that has been an issue of substantial discussion within the Administration as to whether there is statutory authority for large businesses to retain the rights to the technology that has been developed by them under contract.

I think tomorrow you will be hearing from Mike Farrell, the General Counsel of the Department of Energy, and I assume that that would be one of the issues that he will address because obviously the Department of Energy has relationships with very large businesses, in contrast to what we might call small businesses or the nonprofits.

We believe that even though there may not be explicit statutory authority, we nonetheless believe that there is authority that would allow this transfer to occur to the larger entities, and I believe that this matter is one that internally, at least, within the administration is being worked out, satisfactorily worked out.

I might just gratuitously make the observation that it may very well be an issue that the Congress may want to take a look at because it is always better to have something made explicit rather than implicit.

Mr. WALGREN. There are so many circles in our system, and it may be that something that becomes very non-controversial in one circle is not really completely accepted by another, and therefore the deed is not done. But in many groups now that I have had contact with in the Congress, that has been sort of a given for a number of years, and it is disappointing to see it not having been confirmed before.

You indicate that it is important how these departments implement these regulations that apparently now have been issued by OMB; is that right? Particularly the Department of Energy. I know that we would like to specifically address attention to how they are going to move on that and whether there are any limitations in the completeness with which they will go forward in allowing those patents to be appreciated.

Mr. RIGGS. Obviously for the regulations to have been promulgated in final form in March, there was agreement reached within the administration and that agreement obviously included all the relevant agencies, including DOE. I might point out—again this is a gratuitous observation—that my colleague, Mike Farrell, as General Counsel of the Department of Energy, has taken a very positive role in acting as a broker between his agency and our agency in working out some of these disagreements.

I know that he and Assistant Secretary Merrifield have met on a number of occasions, and I am pleased that, to the extent there were any disagreements, they appear to have been worked out. Clearly the fact that the regulations have been promulgated and are now in force and effect reflect the fact that there has been agreement reached.

The other comment that I would make within this context is that in the last 2 or 3 days, in preparation for this hearing I have had an opportunity to spend a great deal of time with our people at the Department of Commerce, and it goes without saying that people in the Department of Commerce are very committed to the concept of technology transfer.

Bruce Merrifield, has criss-crossed this country. I think he has been through this town as thoroughly as anyone can go through this town in putting forth the concept that it is very important to get this information, this technology that is being developed in the Federal labs, out into the stream of commerce. Our people have taken a very aggressive approach in seeing that that policy goal is achieved, and I am impressed by the number of actions that Congress has taken, particularly since the early 1980s.

Then you couple that with the President's memorandum of 1983 and now this Executive order, and you get something which is very broad and very straightforward. It is very compelling in directing the Federal apparatus as to what it should be doing.

Mr. Walgren. You know, in this whole area one of the frustrations is that we can agree on what ought to be done, but unless we measure in some way quite specifically the progress or the change or whatever it is that we are talking about, oftentimes in Government you come away with just the words and not any real change.

That strikes me in a couple of ways. For example, Dr. Merrifield's effort in trying to encourage the joint research consortiums. We have been really highlighting the potential of that kind of arrangement for a number of years now, at least five years, and the question is what is the pickup out there? Is this something that is really going to change people's lives, or is this just a theory that a professor might talk about?

I would like to ask if you wouldn't try to in a later submission measure a couple of things for me, particularly if you can measure the specific actions taken in response to the theory that Mr. Merrifield has been promoting.

[Question and answer follows:]

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[Are Dr. Merrifield's efforts to encourage joint research consortiums really going to change people's lives, or is this just a theory that a professor might talk about?

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Answer

Assistant Secretary Merrifield has for the last several years encouraged the formation of two types of research consortiums. The first is joint research and development ventures within the meaning of the National Cooperative Research Act of 1984, and the second is Research and Development Limited Partnerships (RDLP's). Each of these mechanisms has enjoyed considerable success in the last several years.

1. Research and Development Joint Ventures

The National Cooperative Research Act of 1984, P.L. 98-462, seeks to encourage the formation of joint research and development ventures in several ways. The usual penalty of treble damages for parties found to have violated the antitrust laws is reduced by the Act to actual damages for those qualifying R&D joint ventures which notify the Department of Justice of the formation of the venture. In addition, the rule of reason is established as the standard by which R&D joint ventures will be judged under the antitrust laws. Finally, the Act permits recovery of attorneys' fees by successful defendants if the litigation was "frivolous, unreasonable, without foundation, or in bad faith".

Since enactment of the National Cooperative Research Act in October of 1984, sixty-one cooperative research ventures have been registered with the Department of Justice. New ventures have been forming at a steady rate of roughly two per month. The technological areas where new ventures have formed in the last three years span all sectors of the national economy, and have included groups of large and small firms. Representative technological areas include computer aided manufacturing, software development, continuous casting of steel thin sections, plant biotechnology, cancer drugs, pesticide research, centrifugal pumps and others. Thus, the Act has been an unqualifield success in fostering the establishment of R&D joint ventures.

The results now emerging from the Microelectronics and Computer Technology Corp (MCC) give an early indication of just how valuable these joint ventures may be in improving the competitiveness of U.S. firms in world markets.. MCC, which was one of the first R&D joint ventures to register under the 1984 Act, includes 21 companies, and has an annual budget approaching $75 million. In the last two years, MCC has spun-off two businesses, applied for about fifty patents, produced over 700 technical papers. As more research results begin to emerge over the next several years from both MCC and other R&D joint ventures, a large infusion of technology should contribute substantially to the competitiveness of the firms involved, and to the entire economy.

2. Research and Development Limited Partnerships (RDLPs)

RDLP's have also proliferated over the last several years, with over 200 partnerships funding well over $3 billion in research in the five years that Assistant Secretary Merrifield has worked to encourage their formation. As the only formal source of R&D funding that is independent of government or existing corporate R&D budgets, RDLP's fill a major gap in the innovation process in this country by providing funding for start-up activities. Indeed, a study by New York University concludes that RDLP's may "roughly double the funds available to new technology-based firms." (See Peters and Fusfeld, "Research and Development Limited Partnerships and Their Significance for Innovation", Center for Science and Technology Policy, NYU, April 1986.)

Representative technologies which have been funded by RDLP's include financing clinical trials for biotechnology products that might otherwise have been licensed for manufacture abroad, so-called "smart house" technologies, diagnostic laboratory equipment, and many others. As with R&D joint ventures, the research funded by RDLP's is only beginning to enter the marketplace in this country. The existence of such new technology, much of which would never have been funded without RDLP's, is a strong engine for future economic growth in this country.

Mr. Walgren. You also indicate in your statement that it is clear that the effort to do business on an international basis has been undercut by the failure of our managers to be as careful as they could have been in structuring international joint ventures. Is there some measurement of the size of that failure that you can give us? There are lots of problems internationally, and clearly respect of licensing arrangements is one of them, but I would like to see if we couldn't put a measure on it so that we know that by spending time on that, we are going to catch the right problem.

[Question and answer follows:]

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Answer

There is no in depth data available on international joint ventures which have been detrimental to U.S. business. I am attaching, however, four articles which in anecdotal form emphasize our deficiency in this area. These articles are:

1. Reich and Mankin, "Joint Ventures With Japan Give Away Our Future", Harvard Business Review, March/April 1986;
2. Prokesch, "Stopping the High-Tech Giveaway", New York Times, March 22, 1987;
3. "High Technology", The Economist, August 23, 1986; and
4. Gall, "Does Anyone Really Believe in Free Trade?", Forbes, December 15, 1986.

Harvard Business Review
March-April 1986

Robert B. Reich and
Eric D. Mankin

Joint ventures with Japan give away our future

Listen to what these four businessmen have to say about U.S.-Japanese joint ventures:

"They buy energy-intensive components here, like glass, tires, and steel. But when it comes to things that are labor-intensive, that stays in Japan." – Terrence J. Miller, official, Automotive Parts and Accessories Association.

"People we used to do business with, we can't anymore [because they aren't competitive]. Instead of buying a given part from a supplier down the street in Chicago, I buy it from a supplier down the street in Osaka." – Robert W. Galvin, chairman, Motorola.

"Cross & Trecker is committed to the business of machine tools, but it is not committed to build in the United States all or any portion of the machine tools that it sells here." – Richard T. Lindgren, president, Cross & Trecker.

"First you move the industrial part to the Far East. Then the development of the product goes there because each dollar you pay to the overseas supplier is ten cents you're giving them to develop new devices and new concepts to compete against you." – C.J. Van der Klugt, vice chairman, Philips N.V.

Each of these businessmen is commenting on aspects of a trend that is reshaping America's trade relations with Japan and creating a new context for international competition. Very simply this is the situation: to avert rising U.S. protectionist sentiment, Japanese companies are setting up plants in the United States, either as joint ventures or on their own; to obtain high-quality, low-cost products and components, U.S. companies are making joint venture agreements with Japanese companies. At the same time, U.S. companies are licensing their new inventions to the Japanese. (The *Exhibit* lists recent U.S.-Japanese coalitions in high-technology industries.)

> *"The big competitive gains come from learning about manufacturing processes – and the result of the new multinational joint ventures is the transfer of that learning from the United States to Japan."*

On the surface, the arrangements seem fair and well balanced, indicative of an evolving international economic equilibrium. A closer examination, however, shows these deals for what they really are – part of a continuing, implicit Japanese strategy to keep the higher paying, higher value-added jobs in Japan and to gain the project engineering and production process skills that underlie competitive success. ⊕

In contrast, the U.S. strategy appears dangerously shortsighted. In exchange for a few lower skilled, lower paying jobs and easy access to our competitors' high-quality, low-cost products, we are apparently prepared to sacrifice our competitiveness in a

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Mr. Reich, who teaches political economy and management at Harvard's John F Kennedy School of Government, was director of policy planning at the Federal Trade Commission during the Carter administration. His most recent book is New Deals: The Chrysler Revival and the American System *(Times Books, 1985).*

Mr. Mankin is a doctoral candidate in economics and business at Harvard University. His research focuses on production management and industrial organization.

⊕ because that J. firms has a nationalist perspective [illegible]?

host of industries – autos, machine tools, consumer electronics, and semiconductors today, and others in the future.

Before this trend becomes an irrevocable destiny, U.S. business and government leaders need to review the facts carefully and decide if they should follow a different course. Two questions, in particular, frame the issue: What skills and abilities should be the basis for America's future competitive performance? And how does the current strategy of Japanese investments and joint ventures affect those skills and abilities?

The quotes cited earlier and an examination of U.S.-Japanese coalitions across a range of industries suggest disturbing answers to these questions. Through these coalitions, Japanese workers often gain valuable experience in applications engineering, fabrication, and complex manufacturing – which together form the critical stage between basic research and final assembly and marketing. U.S. workers, in contrast, occupy the two perimeters of production: a few get experience in basic research, and many get experience in assembly and marketing.

But the big competitive gains come from learning about manufacturing processes – and the result of the new multinational joint ventures is the transfer of that learning from the United States to Japan. The Japanese investment in U.S. factories gives the Americans experience in component assembly but not component design and production. Time after time, the Japanese reserve for themselves the part of the value-added chain that pays the highest wages and offers the greatest opportunity for controlling the next generation of production and product technology.

In the auto industry, for example, General Motors has formed a joint venture with Toyota, while Chrysler has teamed up with Mitsubishi, and Ford with Mazda. All three deals mean that auto assembly takes place in the United States. But in each case, the U.S. automakers delegated all plant design and product engineering responsibilities to their Japanese partners. The only aspect of production shared equally is styling. Under the Chrysler-Mitsubishi agreement, the joint venture will import the engine, transmission, and accelerator from Japan.

Or take the example of the IBM PC, which is assembled in the United States. The total manufacturing cost of the computer is about $860, of which roughly $625 worth, or 73%, of the components are made overseas. Japanese suppliers make the graphics printer, keyboard, power supply, and half the semiconductors. America's largest contribution is in manufacture of the case and assembly of the disk drives and the computer.

This trend spells trouble. If a Japanese company handles a certain complex production process, its U.S. partner has little incentive to give its skilled workers the time and resources required to design and debug new products and processes. Thus as their employers turn to Japanese partners for high value-added products or components, America's engineers risk losing the opportunity to innovate and thereby learn how to improve existing product designs or production processes.

Exhibit A sampling of U.S.-Japanese joint ventures

Bendix-Murata Manufacturing Company	Machine tools
Boeing-Mitsubishi Heavy Industries Boeing-Kawasaki Heavy Industries Boeing-Fuji Heavy Industries	Airplanes
Amoco-Mitsubishi Rayon	Lightweight plastic components
General Motors-Fujitsu Fanuc	Machine tools
General Motors-Toyota	Automobiles
Ford-Mazda	Automobiles
Chrysler-Mitsubishi Motors	Automobiles
Westinghouse-Komatsu Westinghouse-Mitsubishi Electric	Robots and small motors
IBM-Matsushita Electric	Small computers
IBM-Sankyo Seiki	Robots
Allen Bradley-Nippondenso	Programmable controllers and sensors
General Electric-Matsushita	Disc players and air conditioners
Kodak-Canon	Copiers and photographic equipment
Sperry Univac-Nippon Univac	Computers
Houdaille-Okuma	Machine tools
National Semiconductor-Hitachi	Computers
Honeywell-NEC	Computers
Tandy-Kyocera	Computers
Sperry Univac-Mitsubishi	Computers

Unless U.S. workers constantly gain experience in improving a plant's efficiency or designing a new product, they inevitably fall behind the competition. This is especially true in high-technology sectors, where new and more efficient products, processes, and technologies quickly render even state-of-the-art products obsolete. For example, as the Japanese moved from supplying cheap parts to selling finished products in the consumer electronics industry, vital U.S. engineering and production skills dried up through disuse. The U.S. work force lost its ability to manufacture competitive consumer electronics products.

The problem snowballs. Once a company's workers fall behind in the development of a rapidly changing technology, the company finds it harder and harder to regain competitiveness without turning to a more experienced partner for technology and production know-how. Westinghouse, for example, closed its color television tube factory in upstate New York ten years ago because it could not compete with Japanese imports. That same plant will soon reopen as a joint venture with Toshiba – but only because Toshiba is supplying the technology. Westinghouse engineers, who had not worked on color television tubes for at least a decade, could not develop the technology alone.

On the other hand, continual emphasis on and investment in the production part of the value-added chain will result in low-cost, high-quality products and a steady stream of innovations in products and processes. If current trends persist, Japanese companies will keep gaining experience and skill in making products. They will continue to develop the capacity to transform raw ideas into world-class goods, both efficiently and effectively.

The implications of this trend for U.S. companies, workers, and the national economy are uniformly bad. The Japanese are gradually taking charge of complex production – the part of the value-added chain that will continue to generate tradable goods in the future and simultaneously raise the overall skill level of the population. The entire nation benefits from a large pool of workers and engineers with skills and experience in complex production.

The United States, however, will own only the two ends of the value-added chain – the front end, where basic research and invention take place, and the back end, where routine assembly, marketing, and sales go on. But neither end will raise our overall skill level or generate a broad base of experience that can be applied across all kinds of goods.

As more and more production moves to Japan, our work force will lose the capacity to make valuable contributions to production processes. An economy that adds little value to the production process can hardly expect to generate high compensation for less valuable functions. If the current trend continues, our national income and standard of living may be jeopardized.

Japan's investment in America

Japanese investment in the United States has given rise to automobile plants producing Nissans, Hondas, Toyotas and, in the near future, Mazdas and Mitsubishis. Japanese semiconductor and computer manufacturers have helped create a "silicon forest" in Oregon. In the last four months of 1984, Japanese electronics companies established 40 new plants in the United States that produce everything from personal computers to cellular mobile telephones. According to the Japan Economics Institute, there are now 522 factories in the United States in which Japanese investors own a majority stake.

Japanese companies are also building laboratories here. Nippondenso's research center in Detroit will focus on automobile electronics and ceramics, and Nakamichi's in California will develop innovations in computer peripherals. Furthermore, nearly every major Japanese company now funds research at American universities in return for the right of first refusal in licensing any products or technologies that are developed.

Although Japanese companies fund basic research at American universities, the results of that research go back to Japan for commercialization. At the other end of the manufacturing process, Japanese plants in the United States take the results of complicated production done in Japan and assemble the final products. NEC's new computer facility in Massachusetts assembles computers from Japanese central processing units and memory chips. The most sophisticated components and systems of automobiles are apt to be produced in Japan, even if the car is assembled in Michigan, California, or Tennessee.

Heart of the matter

At the heart of a growing number of U.S.-Japanese joint ventures is the agreement that the Japanese will undertake the complex production processes. These agreements need not automatically turn out this way. In fact, there are many different types of international joint venture, and each type has different implications for production, distribution, and division of profit between the partners.

Consider the recent agreement between AT&T and Philips N.V., under which Philips will distribute AT&T products in Europe. The two companies each contributed resources to the formation of a new jointly owned entity. AT&T's stated goal was to enter the European market; Philips presumably wanted access to AT&T's products. AT&T could have sold Philips an exclusive European license to manufacture and distribute its products; it could have leased Philips's factories or built its own in Europe and used Philips as a distributor; or it could have bought Philips, a move that would have given it the Dutch company's factories and distribution network, as well as all of its proprietary products.

U.S. companies planning joint ventures with Japan usually find that at least one of these options is unavailable: they cannot buy a Japanese company. Still, U.S. companies can enter a wide range of potential joint venture agreements. Most of the high-technology joint ventures that we examined, however, were agreements in which the U.S. partner would sell and distribute the Japanese product; our study of 33 joint ventures between U.S. and Japanese companies in consumer electronics industries showed that roughly 70% took this form.

Under the typical agreement, the U.S. company buys products from its Japanese partner and sells them in the United States under its own brand name, using its own distribution channels. The IBM graphics printer is made by Epson in Japan. The Canon LBP-CX laser printer is manufactured in Japan and sold in the United States by Hewlett-Packard and Corona Data Systems. Even Eastman Kodak is joining the bandwagon: Canon of Japan will make a line of medium-volume copiers for sale under Kodak's name; Matsushita will manufacture Kodak's new video camera and recorder system, called Kodavision.

This type of arrangement is not unique to U.S.-Japanese joint ventures; European high-technology computer, semiconductor, and telecommunications companies are also entering into a disproportionately large number of sales and distribution agreements with the Japanese.

For many U.S. managers, these joint ventures make good business sense. Faced with seemingly unbeatable foreign competition, many U.S. companies have decided that it is more profitable to delegate complex manufacturing to their Japanese partners. Consider Houdaille Industries, a Florida-based manufacturer of computer-controlled machine tools. Beginning in 1982, the company set out to block imports of competing Japanese machine tools. It petitioned Washington for protection, accusing the Japanese of dumping and receiving subsidies from the Japanese government. When that strategy failed, Houdaille tried to persuade the Reagan administration to deny the 10% federal investment tax credit on equipment to U.S. buyers of Japanese machine tools. The administration rejected this proposal as well. Finally, Houdaille announced that it would seek a joint venture with Japan's Okuma Machinery Works.

The machine tool story

Houdaille is not the only machine tool manufacturer to look for Japanese partners. James A.D. Geier, chairman of Cincinnati Milacron, the nation's largest machine tool manufacturer, noted in 1984 that "50% of the products we sold last year did not even exist five years ago. We've gone from being an industry with very little change in products to one with a revolutionary change in products." Many U.S. companies were unprepared for such a transition and as a result can make money only by selling advanced products manufactured in Japan. In 1983, more than 75% of all machining centers sold in the United States were made in Japan (even though many ended up with American nameplates), and domestic production has declined dramatically.

As imports have increased, international joint venture activity in the machine tool industry has accelerated. A recent National Research Council report on machine tools noted that "most of these joint ventures have offered the potential for low-cost, reliable overseas manufacturing for the U.S. partner, and an enhanced marketing network in this country for the foreign one."[*] For example, Bendix sells a small turning machine in the United States for $105,000. It can produce the device in Cleveland for $85,000. The same machine, produced in Japan by Bendix's new partner, Murata Manufacturing, and then shipped to Cleveland, costs the company only $65,000. Such compelling economics underlie Bendix's decision to transfer nearly all its machine tool production to Japan.

Or consider the case of Pratt & Whitney, which earns profits by distributing foreign-made machine tools. In July 1984, its president, Winthrop B. Cody, told the *New York Times*: "I wish we could make some of these machine tools here, but from a business point of view it's just not possible." Even U.S. companies that develop new products look to Japan for manufacturing. Acme-Cleveland's state-of-the-art numerically controlled chucker, jointly developed with Mitsubishi Heavy Industries, will be produced in Japan.

The semiconductor story

While not in quite the same straits as machine tool producers, U.S. semiconductor manufacturers also face increasing competition from Japan and thus increasing pressure to enter into coalitions with Japanese companies. Traditionally, the Japanese have entered semiconductor markets as followers, thereby enabling U.S. companies to reap high profits before the product's price drops. Once the Japanese enter, they rapidly gain market share by competing on the basis of a lower price.

Some of the most famous examples of the "Japanese invasion" come from the memory chip wars of 1973-1975 and 1981-1983, when U.S. chip makers ceded a large part of the 16k and then the 64k dynamic memory market to Japanese manufacturers producing at lower cost. In the spring of 1984, Japanese manufacturers controlled about 55% of the U.S. market for 64k RAM chips. Taking a lesson from these bat-

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[*] Committee on the Machine Tool Industry, Manufacturing Studies Board, Commission on Engineering and Technical Systems, National Research Council, The U.S. Machine Tool Industry and the Defense Industrial Base (Washington, D.C.: National Academy Press, 1983), p. 44.

"Look at it this way, gentlemen. Minimum tax is better than maximum tax."

ties, some U.S. companies decided to delegate production to the Japanese at the start of a new project: in 1982, Ungermann-Bass made an agreement with Japanese chip maker Fujitsu by which Ungermann-Bass designs very large scale integrated circuits for local area networks. The company then sends the designs to Fujitsu in Japan for manufacturing.

Innovations and new products in the semiconductor industry are a predictable function of experience and engineering know-how: 16k RAM chips precede 64k RAMs, the development of the 16-bit microprocessor follows logically from the existence of its 8-bit forebear. Since technological leadership is linked so closely to production experience, the emergence of pioneering Japanese products will only be a matter of time. In December 1984, for example, Hitachi introduced a 32-bit microprocessor, thus signaling its intention to compete aggressively against U.S. companies in leading-edge semiconductor technologies. While both Motorola and National Semiconductor are producing a 32-bit chip, Hitachi's entry predates Intel's new product announcement. Intel introduced its new 32-bit microprocessor in October of 1985.

Hitachi's push toward state-of-the-art semiconductor production foreshadows a new round of sales and distribution agreements. Soon executives at Intel or National Semiconductor will realize that Hitachi or another Japanese semiconductor manufacturer can sell advanced semiconductor products at prices that U.S. companies cannot match. These semiconductor companies might go to Washington looking for trade protection. More likely, however, they will try to preserve their profitability by negotiating sales and distribution agreements. National Semiconductor already has trading ties with Hitachi through which it markets Hitachi's computer in the United States.

A comparison of two joint ventures – National Semiconductor-Hitachi and Amdahl-Fujitsu – illustrates the different approaches U.S. and Japanese companies take toward joint ventures. Fujitsu and National Semiconductor both fabricate integrated circuits, while Hitachi and Amdahl manufacture IBM-compatible mainframe computers. Both ventures link a computer and a semiconductor manufacturer.

The agreement between National Semiconductor and Hitachi is similar to sales and distribution agreements in other industries. In an attempt to diversify downstream, National Semiconductor will sell Hitachi's IBM-compatible mainframe computers in the United States. Hitachi, however, will be under no obligation to use any National Semiconductor products in making its computer. National Semiconductor may thus find itself in the position of manufacturing chips for Hitachi's competitors while selling a Japanese-made computer that contains none of its own components.

In contrast, Fujitsu purchased a controlling interest in Amdahl in 1983. As a result, Amdahl will now buy from Fujitsu most of the semiconductors it uses in the manufacture of its mainframe computers. Fujitsu will not, however, sell Amdahl computers in Japan. In both cases, Japanese companies add to their manufacturing experience. Complex production stays in Japan, and the final products are sold in the United States.

The story behind the stories

What lies behind Japan's direct investment in the United States and the coalition-building activities of U.S. and Japanese high-technology companies? What motivates U.S. and Japanese managers?

The Japanese hope to mitigate future U.S. trade barriers by investing in the United States ⑦ and allying with U.S. companies. In 1981, nontariff import restrictions protected about 20% of U.S. manufactured goods; by 1984, protection covered 35%. To the Japanese, the trend is clear. If the Reagan administration succumbed so readily to protectionism, what can the Japanese expect from future administrations that may be less ideologically committed to free trade? Mazda is investing $450 million in a new auto assembly plant in Flat Rock, Michigan because quotas had prevented Mazda from importing enough cars to meet demand. Despite the recent expiration of voluntary import restraints on Japanese automobiles, Chrysler and Mitsubishi came to an agreement in April 1985 to assemble Mitsubishi automobiles in Illinois. Concern over future trade barriers was a strong motivating factor for Mitsubishi.

From the Japanese perspective, joint ventures with U.S. companies will also help forestall further protectionism. RCA was notably absent from the 1977 dumping case over Japanese color television sets. Because it had licensed technology to Japanese television manufacturers, RCA was benefiting from Japanese imports. In the same way, now that RCA is distributing a PBX system manufactured by Hitachi, it has no interest in pushing for trade barriers in telecommunications equipment.

In both joint ventures and direct investments, U.S. companies and workers become partners in Japanese enterprises. Japanese direct investment puts Americans to work assembling Japanese-made components. Joint ventures and coalitions employ Americans selling Japanese products. If trade barriers limit the flow of products from Japan, American workers will lose their jobs assembling and distributing these goods and U.S. corporations will lose money.

Why do U.S. companies find joint ventures with Japanese companies so attractive? Companies in emerging industries often view a joint venture with a Japanese company as an inexpensive way to enter a potentially lucrative market; managers in mature industries view the joint venture as a low-cost means of maintaining market share. In industries ranging from consumer electronics to machine tools, the Japanese have the advanced products American consumers want. Joint ventures allow U.S. companies to buy a product at a price below the domestic manufacturing cost. The Japanese partner continues to move down its production learning curve by making products destined for U.S. markets. Thanks to these joint ventures and coalitions, the efficiency gap between U.S. and Japanese manufacturing processes will continue to widen.

A Japanese strategy

The trends of the past 40 years as well as current Japanese actions in the United States suggest the existence of a long-term Japanese strategy. The [illegible] overriding goal of Japanese managers is to keep complex production in Japan. They intend to develop national competitive strength in advanced production methods. U.S. managers who want to take advantage of Japan's manufacturing strength may do so by selling Japanese products in the United States. They may also set up production facilities in Japan, provided they are run and staffed by Japanese.

Increasingly, American managers are aiding the Japanese in achieving their goals by channeling new inventions to Japan and providing a sales and distribution network for the resulting products. Burroughs and Hewlett-Packard, for example, have just set up buying offices in Japan to procure high-tech components from Japanese manufacturers. Over the next five years, we expect sales and distribution agreements to result in lower profitability and reduced competitiveness for the U.S. companies that enter into them.

The reason is simple: the value provided by the U.S. partner in a sales and distribution agreement is potentially replaceable. The U.S. company gives away a portion of its market franchise by relying on a Japanese company for manufactured products – in essence, it encourages the entry of a new competitor. As shown by the Japanese-dominated consumer elec-

[illegible]

tronics industry, these agreements can act like a Trojan horse: the U.S. company provides the Japanese company access to its customers, only to see the Japanese decide to go it alone and set up a distribution network on the basis of a reputation gained with the help of the U.S. partner. Even if the Japanese do not terminate the agreement after establishing a presence in the United States, Japanese manufacturers are in a position to squeeze their U.S. distributors' profit margins precisely because sales and distribution functions are so vulnerable to replacement.

U.S. companies are selling themselves too cheaply; in letting their Japanese partners undertake product manufacturing, they are giving away valuable production experience. Instead, U.S.-based companies could begin to invest in more sophisticated production within the United States. They could seek to develop in our work force the same base of advanced manufacturing experience that Japanese managers are now creating among their workers. Unfortunately, from the standpoint of a typical U.S. company, the guaranteed return on this sort of an investment is often not enough to justify its cost, especially when the alternative of Japanese manufacture is so easy to choose.

Production experience is essentially social. It exists in employees' minds, hands, and work relationships. It cannot be patented, packaged, or sold directly. It is thus a form of property that cannot be claimed by the managers who decide to invest in it and the shareholders they represent. This form of property belongs entirely to a company's work force. It will leave the company whenever the workers do.

An economic fable

Imagine the following: the chief executive of a U.S. company decides to invest in production experience. Instead of relying on a Japanese supplier for a complex component, top management decides to produce it in America, inside its own operation. The component costs more to produce here than in Japan – the equivalent of $1,000 more per employee. The higher cost partly reflects the overvalued dollar, but it occurs mainly because the Japanese have already invested in producing this component cheaply and reliably. The chief executive sees the added expense as an investment. Once the workers and engineers gain experience in making the component, they will be better able to make other products. They will learn about the technology and will be able to apply that learning in countless ways to improve the company's other processes and products. As a result, the company will gain $1,500 per worker in present-value terms. Thus the initial $1,000 investment is well worth it.

As might be imagined, the chief executive cannot get anywhere near the $1,500 return envisioned from this investment. As soon as the workers and engineers realize their increased value, they ask for more money. In this fable, they can, of course, ask for $1,499, since they are now worth an extra $1,500.

If the executive refuses to give the workers a raise, they can simply leave the company and work for the competition. Faced with a sizable loss on the investment, our executive vows that from now on the company will buy advanced components from Japan.

This fable is not so farfetched. Studies show that companies retain an average of only 55% of their engineering trainees after two years. In one study, the factor cited most often by departing engineers was "inadequate compensation," followed closely by "uncertain future with the company" and "higher salary offer elsewhere."[2] Thanks to such high job mobility, the engineers responsible for developing a new product or designing a cost-saving manufacturing process at one company in one year may find themselves using their expertise to help another company in another year – perhaps their first employer's chief competitor. Thus, companies that invest in production experience may ultimately produce profits for the competition.

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[2] Eugene Raudsepp,
Reducing Engineer Turnover,
Machine Design,
September 9, 1982, p. 52.

[3] Andrew Weiss,
Simple Truths of Japanese
Manufacturing,
HBR July-August 1984, p. 119.

The Japanese system of lifetime employment eliminates this problem. While not all Japanese companies subscribe to such a policy, most of the large companies making advanced products for export do. This system makes it unthinkable for workers to join the competition; they would leave behind friends, homes, social status—in short, much more than a job. In this atmosphere, an investment in production experience comes quite naturally. Benefits resulting from such an investment tend to remain with the company.

Furthermore, because of the abundance of engineers and because engineers stay with their original employers, Japanese managers can give factory workers more engineering support. As Andrew Weiss noted in an HBR article, for high-volume, low-technology products like radios, the ratio of production workers to engineers in Japan is about four to one. In divisions making more sophisticated products, such as very large scale integrated circuits, the Japanese manufacturers observed by Weiss employed more engineers than production workers. Weiss attributes the high levels and rapid increases in Japanese companies' labor productivity to heavy investment in engineering. Most conventionally organized U.S. companies, faced with high turnover, cannot afford to invest so heavily in their engineers.

As a result of these organizational differences, U.S. managers have little incentive to invest in production experience. The Japanese, however, will be able to capture most of the returns from their investments in Japanese workers. U.S. managers are happy to buy components from the Japanese or build new factories in Japan, thus further contributing to the production experience of the Japanese work force. But what is really at stake is not where company headquarters are located or profits remitted, but rather the value added by a nation's work force to an increasingly global process of production and the capacity of that work force to generate new wealth in the future. We are falling behind in this high-tech race, and actions taken by both U.S. and Japanese companies only serve to further weaken the U.S. work force.

Changing course

The current situation has severe drawbacks for U.S. companies over the next five years. Over the long term, U.S. companies that enter joint ventures with Japan cannot maintain high profitability by providing services, such as assembly and distribution, which add very little value to the product being sold. The resulting interplay, while superficially promising, could really be just an extended dance of death.

Profit sharing?

As profits dwindle, management might at last look to profit sharing or other forms of employee ownership that reduce turnover rates. The lower the turnover, the more profitable are investments in the work force. Furthermore, profit-sharing programs will enable workers to gain directly from a company's investments in them. To return to our fable, when workers in a company practicing profit sharing demand their raises, our chief executive need only say, "Wait, and you will get higher compensation when our investments start paying off and the company makes more money."

In practice, however, it may be impossible to devise a profit-sharing system that solves the problem. In a large company, for example, employees of different divisions would have to be compensated based on their divisional performance—a difference sure to create resistance to transfer among divisions, which makes it hard to share production experience. Furthermore, a new system of ownership and an immediate change in managerial or worker attitudes do not automatically go together. Consider Hyatt Clark Industries of Clark, New Jersey, a worker-owned company in which management refused to distribute company profits, or the Rath Packing Company of Waterloo, Iowa, a worker-owned company in which the workers went out on strike.

Moreover, corporate objectives are often inconsistent with a goal of profit sharing or employee ownership. Unlike workers, corporations can move overseas. Why make risky investments in workers when safer Japanese alternatives present themselves? If we wait for U.S. corporations to increase their investments in their workers, we may have to wait too long. The plants that these companies will eventually sell to their workers will be obsolete, and America's comparative disadvantage will be too great to overcome.

Public benefits, private costs

In this situation, government has an appropriate role. The difference between the social and private returns on investments in production experience is an example of what economists call an "externality." Other examples of externalities abound: when a company pollutes the air, it is using a public resource—clean air—for which it is not paying. The private company is, in essence, shifting a cost to the public—and thereby boosting its rate of return at public expense. In this case, government's role is to ensure that the company's costs reflect the value of resources used in production. The clean air regulations of the

1970s made managers include the costs of pollution – or pollution cleanup – in their investment decisions.

In the case of production experience, the balance between cost and reward is reversed: society as a whole benefits more than do most companies from investments in workers and engineers. Government should thus create incentives for companies that are doing business in the United States – regardless of where the company is headquartered – to invest in complex production here, using American workers and engineers. Companies should reap an extra public reward for investing in production experience to make up for the diminished short-term private reward of doing so. The government could subsidize investments in production experience through, for example, a human investment tax credit. The object would be for government to accept part of the economic cost of creating an important national economic good: more highly skilled, trained, and experienced workers and engineers.

In addition, government could support private investment in production experience in other, less direct ways. Federal and state governments could sponsor "technology extension services" modeled on the highly successful agricultural forerunner. An extension service could inform smaller businesses about the latest methods in manufacturing technology and undertake pilot programs and demonstrations. By sharing information and conducting classes, an extension service could help smaller manufacturers – the underpinnings to the industrial base – keep pace with change.

For another perspective on this same topic, see "Cooperate to Compete Globally" by Howard V. Perlmutter and David A. Heenan on page 136 of this issue.

Antitrust laws could be modified to permit American companies to invest jointly in complex production in the United States, thereby spreading the cost of the investment over several companies. The Federal Trade Commission allowed General Motors and Toyota to form a joint venture; would it have also approved a GM-Ford deal?

Our future national wealth depends on our ability to learn and relearn how to make things better. The fruits of our basic research are taking seed abroad and coming back home as finished products needing only distribution or components needing only assembly. America's capacity to produce complex goods may be permanently impaired. As a production-based economy, the United States will be enfeebled. What will also be lost is the wealth – the value added – contributed by the center of the value-added chain. And that is a prospect that should concern executives and government leaders alike. ▽

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Section 3

Stopping the High-Tech Giveaway

By STEVEN PROKESCH

WHEN Reagan Administration opposition forced Fujitsu Ltd. to drop its plans to buy control of the Fairchild Semiconductor Corporation last week, Fujitsu and Fairchild executives immediately made it clear that their relationship was not dead. The two companies now plan to enter into a series of technology-exchange and development programs and joint manufacturing projects that will enable the companies to make and sell each other's products.

By teaming up with a foreign company in such a fashion, Fairchild is merely joining the pack. So-called cooperative ventures or strategic alliances with foreign companies have become a way of life in nearly every industry. Hundreds of American companies have turned to foreign partners for assistance in dealing with intensifying global competition, penetrating foreign markets and shouldering the big costs of developing sophisticated new products.

But even though there was no immediate outcry from Washington, Fujitsu's and Fairchild's plans to live together rather than marry still carry some of the same risks of transferring technology to Japan that had caused Government officials to oppose the proposed acquisition. Indeed, there are growing concerns in business, Government and academic circles that such American-foreign alliances have resulted in a largely one-way flow of technology and other critical skills from the United States to foreign nations, especially Japan. And while many American companies are loath to talk about it, a broad reassessment of alliances with foreign companies is clearly under way.

Many of the competitive problems now plaguing American manufacturers of such products as semiconductors, machine tools and consumer electronics stemmed from ties with foreign companies.

When the RCA Corporation licensed its color television technology to the Japanese decades ago, its leaders saw the deals as a low-risk way to make some easy money. RCA is still pocketing handsome royalties, but the Japanese now have a bigger share of the American market than the RCA brand.

More recently, cooperative ventures have come back to haunt the semiconductor industry. As recently as the early 1980's, American semiconductor makers were a symbol of America's technological might. But by entering into a range of licensing, marketing and manufacturing ties with American companies, the Japanese assimilated everything the masters had to teach. Now the Japanese are the masters, and the Americans are scrambling to catch up.

The big worry is that what happened in color televisions and electronics is happening everywhere. If American companies do not change their approach to cooperative ventures, the resulting transfer of technology to foreign countries, especially Japan, could ultimately threaten the nation's dominance of other key industries, including biotechnology, telecommunications, computers and aerospace, according to Government and business officials and experts who have studied the phenomenon.

"There is hardly an industry where we haven't transferred technology to Japan," said Clyde V. Prestowitz, who as counselor to the Secretary of Commerce was one of the nation's top trade negotiators with Japan from 1981 to mid-1986. "If we give our technology away, we have nothing to compete with," he added.

Mr. Prestowitz may sound like he was stating the obvious, but it was something that a lot of managers

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American businesses have given away precious technology in ventures with foreign companies. Now they share less, and try to get something in return.

1 Superconductor Articles
2 2-Pager
3. Executive Order

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Continued from Page 1

were painfully slow to recognize.

Many American executives clung to the belief that the Japanese had no technology of worth long after that was no longer the case. Why? Tradition was one reason. Sheer arrogance was another.

After World War II, the United States Government encouraged American companies to share their technology to help rebuild the war-ravaged economies of Europe and Japan. Long after that task was accomplished, the technology outflow continued. Having dominated the world markets for so long, many American businessmen seemed incapable of seeing the Japanese as their equals let alone their superiors. Confident of their ability to stay at least one step ahead of the Japanese, they did not worry that they were helping the Japanese become formidable competitors.

Such talk can still be heard at aerospace companies such as Boeing and Pratt & Whitney, which enjoy a technological lead — at least for now. "I don't see the Japanese or anyone else developing competitive technology by associating with us," said Robert Rosati, a recently-retired Pratt & Whitney official who led its joint ventures with companies from Japan and three other nations to develop jet engines. "They don't have the design or development capability to do any kind of engine, and they're not going to get them."

But plenty of humbled executives in industries ranging from chemicals and cars to semiconductors and machine tools have wised up. "Anytime you license a foreign company to manufacture and perhaps sell for you, you're in effect putting another competitor into the marketplace," said B. Charles Ames, chief executive of the Acme-Cleveland Corporation. "Anybody who doesn't realize that is pretty damn naïve."

"Giving up technology is now far more suspect," said John M. Stewart, who advises major corporations on technology issues for McKinsey & Company, the consulting firm.

ALARMED by the travails of the semiconductor industry, executives at the Ford Motor Company recently decided against entering into a venture with the Japanese to produce a high-technology component for the power train of its cars. And General Electric has become much more cautious about licensing its "best high technology" to the Japanese, said Philip V. Gerdine, a G.E. executive. General Electric's "wariness" of the Japanese "has gone up as our respect for them has gone up," he said.

The Intel Corporation, the semiconductor maker, licensed a half-dozen domestic and foreign manufacturers, including Fujitsu and NEC, to make its first microprocessor for the International Business Machines Corporation's personal computer and compatible machines. For its new third-generation microprocessor, it will license no more than two companies and maybe none.

Acme-Cleveland once licensed Mitsubishi Heavy Industries to manufacture and sell one of its machine tools only to watch Mitsubishi become its rival in the United States market. Acme-Cleveland incorrectly assumed Mitsubishi's ambitions were limited to Asia. Now, in choosing a Japanese company to make some of its telecommunications equipment, Acme-Cleveland is being "darn careful to make sure the company that is going to manufacture it for us does not have any apparent interest in getting into this market," said Mr. Ames. And Acme-Cleveland, he said, will make sure that its licensing agreements include market restrictions.

Companies that had relied on joint ventures to compete in Japan are now establishing wholly owned subsidiaries. Duracell, Kraft Inc.'s battery subsidiary, did that last November, when it canceled a venture with Sanyo Electric. E.I. du Pont de Nemours & Company is operating new businesses in Japan on its own and is shifting some activities of its existing Japanese ventures to a subsidiary, according to William H. Davidson, an associate professor at the University of Southern California's Graduate School of Business. Carl De Martino, a Du Pont group vice president, said: "Given our free choice, we would prefer to have a 100-percent-owned company anywhere."

American companies, when they do contribute technology to a venture, are demanding technology of equal value in return, something many had not done as recently as five years ago.

"There's a greater sensitivity to the need to get a two-way exchange as opposed to the one-way flow, which was fundamentally the way most joint ventures in the last 20 years were structured," said S. Allen Heininger, a vice president of Monsanto and president-elect of the Industrial Research Institute, an organization of senior research officials from major companies.

Under the terms of a new joint venture in semiconductors with the Toshiba Corporation, for example, Motorola Inc. will give Toshiba some of its microprocessor technology but will receive Toshiba's "very leading edge" technology in memory chips and manufacturing, said Keith J. Bane, Motorola's director of strategy.

To insure that the technology flows both ways, a growing number of American companies are insisting that their managers be involved in ventures in Japan. Celanese (which was bought by Hoechst of West Germany earlier this year) trained two of its employees to speak Japanese and put them into a joint venture with Daicel Chemical Industries to soak up Daicel's expertise in automotive plastics. They are now back in Detroit working to apply what they learned.

While many joint ventures in Japan have been confined to manufacturing and marketing, more American companies are insisting that they do research and development. Only 5 percent of the new ventures formed in Japan in 1973 involved research and development, but 35 percent of those formed in 1985 did, according to a study by Laurent L. Jacque, an assistant professor at the University of Pennsylvania's Wharton School.

At the very least, some American companies are using ventures as a way to master Japanese management techniques. That was a key motive for General Motors's joint venture with Toyota to make small cars in California.

UNLIKE American managers, foreign businessmen, especially the Japanese, long ago realized that they could exploit these alliances for more than just quick gains in market share or short-term profits. For them, ventures were a way to gain the technology and skills needed to achieve global leadership.

In his studies of such ventures, including five of Du Pont's in plastics, Professor Davidson found a pattern. The Japanese company would assimilate its American partner's technology or production skill and then squeeze out the American partner.

Such a squeeze led to the split-up last summer of a venture between Humphrey Instruments, a California concern, and Hoya Glass of Japan. "Hoya developed the ability to produce the machines on its own and effectively terminated the agreement," Professor Davidson said.

One reason that the Japanese often seem to end up with the upper hand is that they frequently wield total management control of the venture. Several of the Du Pont ventures that Professor Davidson studied had no American managers.

An even more basic problem, according to several experts, is that many more Japanese speak English than Americans speak Japanese.

This has made it difficult for Monsanto, the chemicals concern, to make sure it was getting as valuable technology from its Japanese partners as it is giving to them.

"We have few scientists who are proficient in Japanese," Mr. Heininger said. As a result, "we don't have the fluency to probe in detail their technical people the way they can probe in detail our technical people."

The Japanese have not been nearly as generous about sharing their technology and manufacturing expertise, contends Robert B. Reich, professor of political economy and management at Harvard University's Kennedy School of Government. In his study of 100 ventures, he found that Japanese companies almost always tried to keep the highest value-added parts of production for themselves.

If this trend continues, he worries that the Japanese will increasingly be the ones who turn American breakthroughs in basic science into useful products. Americans, he said, will become second-class assemblers and distributors of Japanese goods.

In many cases, though, American companies have had little choice but to form disadvantageous relationships to do business in Japan.

Until the mid-1970's, the Japanese prohibited Americans from setting up wholly owned subsidiaries in Japan. Instead, they had to enter into jointly owned enterprises with Japanese companies. And the price of entry into Japan included a requirement to license their technology to Japanese concerns.

Even after these laws were relaxed, American companies frequently found it difficult to break into the Japanese market on their own. This has been especially true in such expensive, technologically sophisticated products as telecommunications equipment and commercial aircraft, where the Japanese Government — like the governments of most countries — plays a big role in determining which vendor wins an order. As is still the case in most countries, including Japan, sharing technology and production with local companies is a prerequisite for winning an order.

Cultural differences have also made it virtually impossible for American companies to compete on their own in Japan.

The long-term relationships between suppliers, manufacturers and distributors so valued in Japan hinder American companies. With acquisitions frowned upon in Japan, American companies have often had little choice but to team up with a Japanese company to break into the market.

DESPITE all the dangers, strategic alliances with foreign companies, including the Japanese, seem here to stay. Indeed, even with the reassessment of ventures going on, no one expects any significant slowdown in their formation.

American inventiveness is admired throughout the world, but small companies, which account for so many discoveries, must often turn to foreign partners for help in mak[illegible] — distributing their products — and for the capital needed to stay alive.

Even giants, though, will continue to link up with foreign companies. General Motors, Ford and Chrysler now import not only components but entire cars from Asia. Companies in businesses ranging from appliances to photocopiers to machine tools have resorted to the same tactic. Such arrangements often force the American company to disclose vital design or product information.

Business leaders have also come to view strategic alliances as a necessity in industries where product development costs are exorbitant.

It costs $30 million to $100 million to bring a new drug to market, so pharmaceutical companies have to market it rapidly throughout the world to recoup the investment. That requires strategic alliances, said Henry Wendt, president and chief executive of the SmithKline Beckman Corporation, which has joint development and marketing agreements with Boehringer Mannheim of West Germany, Fujisawa of Japan and Wellcome P.L.C. of Britain.

Similarly, virtually no single company can afford the billions of dollars it costs to develop a new commercial jet — not to mention the $500 million to $700 million to develop the engines to power it. For that reason, international consortiums have become a way of life in the aerospace industry.

In a recent interview, Makoto Kuroda, a senior official of the Japanese Ministry of International Trade and Industry, reiterated his Government's assertion that Japan has abandoned all ambitions to become an independent power in commercial jets. At least publicly, such aerospace companies as Boeing and Pratt & Whitney, the jet engine maker, say the Japanese lack the design and systems ability and the innovativeness to threaten American leadership in aircraft or engines. But privately, industry officials are nervous, said Leslie Demond, a McKinsey consultant.

Whatever their long-term intentions might be, Japanese clout — and expertise — is clearly growing.

Boeing will allow its Japanese partners to design and produce components equal to 25 percent of the value of the 7J7, the 150-seat, fuel-efficient jet that Boeing plans to have in service in the early 1990's. That is about twice the share that the Japanese produced of the 200-seat 767.

Even if the Japanese pose no immediate threat to prime contractors such as Boeing, they are already taking business away from American component suppliers, said David C. Mowery, an aerospace expert at Carnegie-Mellon University. Eventually, they may do the same to the prime contractors, according to many experts.

SLOWLY, painfully, American managers are learning that doing business in a global economy carries enormous dangers along with opportunities. Having been burned by foreign alliances, some managers, at least, have lost the arrogance that made them such easy prey. The question is whether managers in other industries will learn from their example, or have to learn on their own. ■

The Government **Tries to Help**

Government officials are attempting to limit the dangers posed by the proliferating ties between American and foreign companies by enacting new laws and relaxing old ones.

Until a new law was enacted last year, pharmaceutical companies could not sell products for clinical testing or sale abroad unless the Food and Drug Administration had approved them for testing or sale in the United States. That forced such biotechnology companies as Genentech to license their technology to foreign companies instead of supplying their products abroad themselves. "We now have less need to transfer technology," said Thomas D. Kiley, Genentech's vice president for corporate development.

Once it was virtually impossible for American semiconductor companies to protect their mask designs — the "negatives" from which semiconductors are made — from foreign pirates. But new laws have substantially strengthened copyright protection of masks and microcoding instructions implanted in semiconductors. Combined with the designation of a special Federal court to hear patent-infringement cases, that has had a dramatic effect: 70 to 80 percent of such suits are now upheld, up from 20 to 30 percent before.

A 1984 law enabled semiconductor makers to engage in joint research. A group of electronics companies then formed a research consortium, the Microelectronic and Computer Technology Corporation. A Pentagon advisory group is supporting the formation of a semiconductor consortium to develop manufacturing technology and engage in limited production of chips.

To keep the aerospace industry competitive, the President's Office of Science and Technology Policy recommended in February that American companies be allowed to collaborate not only on research for superfast aircraft but also on development — something antitrust laws now bar.

"There is no hysteria now about the aerospace industry's competitiveness," said Crawford F. Brubaker, Deputy Assistant Secretary of Commerce. "But given what has happened in other industries, we don't want it to happen in this one." ■

The Varieties of Business Alliances

Joint Ventures involve the creation of an enterprise jointly owned by the parent companies to develop or manufacture or sell particular products often in a particular market. In many American-Japanese joint ventures, the Americans contributed the technology, only to find themselves discarded when their Japanese partner had mastered the innovation.

Licensing Agreements typically permit the licensee to manufacture and sell a product incorporating the owner's technology in return for royalty payments. But in electrical power plant equipment, color television sets, machine tools, electronic components and many other industries, agreements have not limited licensees to a given market or product application. By improving on the technology itself, capitalizing on their lower manufacturing costs or applying the technology to new products, Japanese companies have used the license to become strong competitors in the United States and abroad.

Marketing/Manufacturing/Supply Arrangements enable a partner to make or sell and service the other's products. American companies have used these arrangements to import low-cost foreign components or entire products, and to distribute American-made products in foreign markets. Because such alliances often involve sharing American technology and design specifications with the foreign partner, the result has often been one-way technology transfer.

Through gift, theft and license, our technology is leaking abroad almost as fast as we develop it. So scratch the long-term dream of a U.S. living off exports of high-technology goods and services.

Does anyone really believe in free trade?

By Norman Gall

Never mind if the U.S. loses its manufacturing skills, we'll just import manufactured goods and pay for them by exporting high technology and knowledge-oriented products. Steel in, software out. Autos in, microchips out.

That's a comforting theory held by a lot of people. Is it workable? Increasingly it looks as if it is not workable. The whole concept is being seriously undermined as U.S. innovations in technology are adopted not only by Japan but also by such fast-developing countries as South Korea, Brazil, Taiwan, even India.

While these countries are more than happy to sell us manufactured goods, they closely control their own imports of technology goods they buy from us. Exports of computers and other high-technology products from the U.S. are still huge, but the long-term prospects are in question. In areas of medium technology, minicomputers in particular, developing countries are adapting or stealing U.S. technology or licensing it cheaply to manufacture on their own. Many of the resulting products are flooding right back into the U.S.

The Japanese developed this policy to a fine art: Protect your home market and then, as costs decline with volume, manufacture for export at small marginal cost. A good many developing countries have adopted the Japanese technique.

Against such deliberate manipulation of markets, what avails such a puny weapon as currency devaluation? Whether the dollar is cheap or dear is almost irrelevant. Free trade is something we all believe in until it clashes with what we regard as vital national economic interests.

These are the broad trends. Now meet Touma Makdessi Elias, 41, an engineer born in Aleppo, Syria. Elias has a master's degree in computer science from San Jose State, in Silicon Valley, and a doctorate from the Cranfield Institute of Technology in England. Grounded in European and U.S. technology, Elias is now a Brazilian.

His company, Microtec, is Brazil's first and biggest producer of personal computers. Elias came to São Paulo eight years ago to teach night classes in engineering. In 1982 the Brazilian government banned imports of small computers. Seizing the opportunity, Elias started making the machines in the basement of a supermarket in the industrial suburb of Diadema.

Technology? "We worked from IBM technical manuals," Elias told FORBES. "We had a product on the market by 1983. We started making 20 machines a month. Soon we'll be making 2,400. Now my brother may be joining our firm. He's a graduate of the Sloan School of Management at MIT. He's been managing an investment company in Dubai, in the Persian Gulf, but we need him here. Brazil is one of the world's fastest-growing computer markets."

There you have it in a nutshell: foreigners, some of them U.S.-educated, copying—stealing, to be blunt—U.S. technology and reproducing it with protection from their own governments. An isolated development? No, this is the rule, not the exception, in much of the world. How, under such circumstances, can the U.S. expect to reap the fruits of its own science and technology?

Time was when technology spread slowly. Communications were sluggish and nations went to great lengths to keep technological innovations secret. In northern Italy 300 years ago, stealing or disclosing the secrets of silk-spinning machinery was a crime punishable by death. The machines were reproduced in England by John Lombe only after he spent two years at risky industrial espionage in Italy. At the height of the Industrial Revolution, Britain protected its own supremacy in textile manufacture through laws banning both exports of machines and emigration of men who knew how to build and run them.

These embargoes on the export of technology were eventually breached. France sent industrial spies to England and paid huge sums to get British mechanics to emigrate. By 1825 there were some 2,000 British technicians on the European continent, building machines and training a new generation of technicians. A young British apprentice, Samuel Slater, memorized the design of the spinning frame and migrated to the U.S. in 1789, later establishing a textile factory in Pawtucket, R.I. So, in the end, the technology became commonplace, but it took decades, and, in the meantime, England was profiting handsomely from its pioneering.

Not so today, when 30% of the students at MIT are foreigners, many destined to return to their native lands and apply what they learn of U.S. technology. What once was forbidden, today is encouraged. Come share our knowledge.

Consider the case of Liaung Shu Lee, born in Canton, China in 1949, raised in Rio de Janeiro, now product planning manager for SID Informatica, one of Brazil's big three computer companies. Like many leading Brazilian computer technicians, Lee is an engineering graduate of the Brazilian air force's prestigious Aerospace Technical Institute near São Paulo. Born in China, raised in Brazil, educated in the U.S. "When I was only 24," Lee says, "I was sent to the U.S. to debug and officially approve the software for the Landsat satellite surveys devised by Bendix Aerospace." Lee later worked eight years with Digital Equipment's Brazilian subsidiary.

Like Microtec's Elias, Lee had learned most of what he knew from the Americans. In teaching this pair—and tens of thousands like them—U.S. industry and the U.S. academies created potential competitors who knew most of what the Americans had painfully and expensively learned. Theft? No. Technology transfer? Yes.

In Brazil over the past few years, the Syrian-born, U.S.-educated Elias played cat-and-mouse with lawyers representing IBM and Microsoft over complaints that Microtec and other Brazilian personal computer makers have been plagiarizing IBM's BIOS microcode and Microsoft's MS-DOS operational software used in the IBM PC. The case was settled out of court. Brazilian manufacturers claimed their products are different enough from the original to withstand accusations of copyright theft.

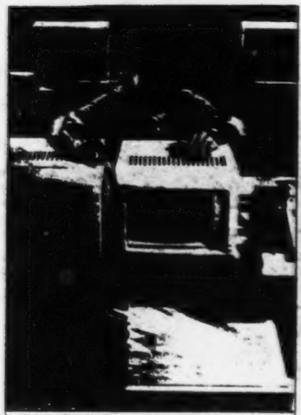
Where theft and copying are not directly involved in the process of technology transfer, developing countries find ways to get U.S. technology on terms that suit them. They get it cheaply. Before President José Sarney departed for his September visit to Washington, the Brazilian government tried to ease diplomatic tensions by announcing approval of IBM's plans to expand the product line of its assembly/test plant near São Paulo. IBM will invest $70 million to develop Brazilian capacity for producing the 5-gigabyte 3380 head disk assembly (HDA).

Ah, but there is a tradeoff involved in the seeming concession by the Brazilians. The tradeoff is that IBM's expansion will greatly improve the technical capabilities of local parts suppliers to make a wider range of more sophisticated products. About a third of the key components in IBM's HDA catalog will be imported, but Brazilian suppliers will get help in providing the rest, some involving fairly advanced technologies.

But does what happens in Brazil matter all that much? Brazil, after all, is a relatively poor country and accounts for a mere $3 billion in the U.S.' $160 billion negative trade balance. Brazil matters very much. For one thing,

[illegible]

Microtec's personal computer factory in São Paulo
Designs cribbed from IBM technical manuals, but different enough to withstand accusations of copyright theft.



Microtec founder Toume Mokdessi Elias
From Syria to São Paulo via Silicon Valley.

IT'S AMAZING
IIGS
INFO
INFO
SOFTWARE
PC

Newsstand in São Paulo
Plenty of reading choices for computer hackers, too.

what happens there happens in similar ways in other developing countries—and some developed ones as well. Brazil, moreover, is fast adapting to the computer age. The Brazilian computer industry employs over 100,000 people. It includes everything from the gray market of São Paulo's Boca de Lixo district to the highly profitable overseas subsidiaries of IBM and Unisys. Both subsidiaries have been operating in Brazil for more than six decades and, for the time being, have been profiting from Brazil's closed-market policies. It includes many manufacturer/assemblers of micro- and minicomputers and of peripherals. Companies also are appearing that supply such parts as step motors for printers and disk drives, encoders, multilayer circuit boards, high-resolution monitors, plotters and digitizers. The Brazilian market is bristling with new computer publications: two weekly newspapers, ten magazines and special sections of daily newspapers.

Brazil is only a few years into the computer age. Its per capita consumption of microchips works out to only about $1.40 per capita among its 140 million inhabitants, vs. $100 in Japan, $43 in the U.S. and about $6 in South Korea. But given the potential size of the market and Brazil's rapid industrialization, it could one day absorb more personal computers than France or West Germany.

The point is simply this: In their natural zeal to make Brazil a modern nation rather than a drawer of water and hewer of wood, its leaders are determined to develop high-technology industry, whether they must beg, borrow or steal the means. Failing to develop high-technology industry would be to court disaster in a country where millions go hungry. But in doing what they must, the leaders of Brazil and other developing countries run strongly counter to the economic interests of the U.S.

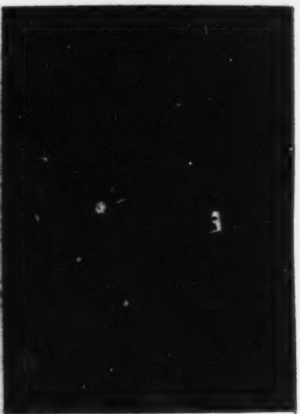
Because of these nationalistic policies, foreign-owned firms are banned from competing in Brazil's personal computer and minicomputer market. Brazil's computer industry is not high tech, if that means being near the cutting edge of worldwide technological advance. But it does show the ability of Brazilian businessmen and technicians to shop for and absorb standard technology, without paying development costs. In computers, where knowledge is the most expensive component, it becomes cheap to manufacture if you get the knowledge free or almost free. The U.S. develops, Brazil copies and applies. There are perhaps a dozen Brazils today.

"We're a late entry and can pick the best technology," says Ronald Leal, 36, co-owner of Comicro, a CAD/CAM equipment and consulting firm. "We don't waste money on things that don't work. [illegible] 1983 we saw a market here for CAD/CAM done with microcomputers. We shopped around the States and made a deal with T&W Systems, a $10 million California company that has 18% of the U.S. micro CAD/CAM market. T&W helped us a lot. We sent people to train and they came to teach us."

Comicro learned fast. Says Leal: "We developed new software applications that we're now exporting to T&W."

Brazil exporting computer designs to the U.S.? Only five years after IBM began creating a mass market for the personal computer, the U.S. home market is being invaded by foreign products—of which Comicro's are only a tiny part. Technological secrets scarcely exist today.

Aren't the Brazilians and the others simply doing what



[illegible] of SID Information
Theft? No. Technology transfer? Yes.

the U.S. did a century and a half ago—protecting its infant industries?

If that were all, the situation might not be so serious for the U.S. But pick up any U.S. newspaper these days and count the advertisements for Asian-made personal computers claiming to be the equivalent of the IBM PC but selling at maybe two-thirds of IBM's price.

According to Dataquest, a market research firm, Asian suppliers will produce nearly 4.5 million personal computers this year. At that rate, they should capture one-third of the world market by next year. Taiwan now is exporting 60,000 personal computer motherboards and systems monthly, 90% of which are IBM-compatible. Of these, 70% go to the U.S. and most of the rest to Europe. Korea, Hong Kong and Singapore together ship another 20,000 each month.

Dataquest says it takes only three weeks after a new U.S.-made product is introduced before it is copied, manufactured and shipped back to the U.S. from Asia.

Thus the U.S. bears the development costs while foreigners try to cream off the market before the development costs can be recouped. That is the big danger. The days when a person could be executed for industrial espionage are gone.

President Reagan recently warned that the U.S. is being victimized by the international theft of American creativity. Too many countries turn a blind eye when their citizens violate patent and copyright laws. In 1985-86 U.S. diplomats successfully pressured Korea, Singapore, Malaysia, Taiwan, Hong Kong and Thailand to pass or at least to draft legislation enforcing patents and copyrights more strictly. Brazil is a major holdout.

The difficulties between Brazil and the U.S. over computers crystallized in the 1984 Informatics law, which Brazil's Congress passed overwhelmingly near the end of two decades of military rule. The law, in effect, legalizes stealing—so long as the victims are U.S. technology exporters. Complains the head of a leading multinational whose business has been curtailed under the new law: "They want our technology but want to kill our operations. This whole show is sponsored by a handful of sharp businessmen with connections in Brasilia who are making piles of money from their nationalism."

The new law formally reserved the Brazilian micro- and minicomputer market for wholly owned Brazilian firms. It allowed wholly owned subsidiaries of foreign companies—IBM and Unisys—to continue importing, assembling and selling mainframes, but not out of any sense of fairness. It was simply that Brazilian companies were unable to take over that end of the business.

Under the law, joint ventures with foreign firms were allowed only if Brazilians owned 70% of the stock and had "technological control" and "decision control."

The main instruments for implementing this policy were tax incentives and licensing of imports of foreign hardware and knowhow, all to be approved by the secretariat of information science (SEI).

In 1981 Brazil's then-military government decreed that SEI would control the computer and semiconductor industries and imports of any and all equipment containing chips. The implications are especially ominous for U.S. interests. Brazil's SEI is modeled, quite openly, on Japan's notorious Ministry of International Trade & Industry (MITI). Brazil's computer policy today follows the line of a mid-Fifties report by MITI's Research Committee on the Computer.

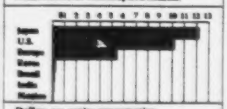
In the 1950s and 1960s MITI used Japan's tight foreign exchange controls to ward off what its nationalist superbureaucrat of the day, Shigeru Sahashi, called "the invasion of American capital." In long and bitter negotiations in the late Fifties, Sahashi told IBM executives: "We will take every measure to obstruct the success of your business unless you license IBM patents to Japanese firms and charge them no more than 5% royalty." In the end, IBM agreed to sell its patents and accept MITI's administrative guidance on how many computers it could market in Japan. How many Japanese products would be sold in the U.S. today if this country had imposed similar demands on the Japanese?

Some U.S. economists are describing the result of the Japanese policy as the "home market effect." They mean that protectionism in the home market tends to create an export capability at low marginal cost.

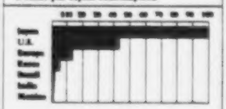
Where the chips fall

No matter how you slice it, per capita or by dollar volume, most of the world's semiconductors go to the U.S., Japan and Europe. Don't be misled, though. The smaller markets matter, especially to the governments that work so hard to protect them.

Semiconductor consumption (billions)



Dollars per capita consumption



"Home market protection by one country sharply raises its firms' market share abroad," says MIT's Paul Krugman, reporting the results of computer simulations of international competition in high technology. "Perhaps even more surprising, this export success is not purchased at the expense of domestic consumers. Home market protection lowers the price at home while raising it abroad."

Brazil surely has similar intentions. IBM and other U.S. computer companies are transferring technology to Brazil as never before.

The Brazilians may have grasped a reality that the U.S. has been unable politically to address: that while there is no way to check the fast dissemination of technology today, the real prize in the world economy is a large and viable national market—a market big enough to support economies of scale and economies of specialization. In short, while a country can no longer protect its technology effectively, it can still put a price on access to its market. As owner of the world's largest and most versatile market, the U.S. has unused power.

Taiwan, Korea, Hong Kong and Singapore, lacking large internal markets, could develop only because they had easy and cheap access to the rich U.S. market.

Why doesn't the U.S. reciprocate? The Reagan Administration has threatened to restrict imports of Brazilian exports to the U.S. by Dec. 31 if Brazil doesn't 1) protect software with new copyright legislation, 2) allow more joint ventures with foreign firms, and 3) publish explicit rules curtailing SEI's arbitrary behavior.

But the Brazilians are hardly trembling in their boots. Brazilian officials hint that if Brazilian exports to the U.S. are curbed, Brazil won't be able to earn enough dollars to service its crushing external debt. Diplomats of both countries want to avoid a showdown, so they keep talking. And while they talk, the Brazilians do what they please.

U.S. Customs has responded to manufacturers' complaints by stopping pirated products at the border. But the Taiwanese now have such cost advantages that they can easily afford to license technology that they have already copied. The Koreans are more scrupulous, but pirated technology not reexported to the U.S. is very hard to control.

More than three years ago Edson de Castro, president of Data General, told a Commerce Department panel that foreign nations' computer policies "threaten the structure and future of the U.S. computer industry." De Castro explained why: "U.S. computer companies are reliant on international business and derive a substantial portion of revenues from exports. Because of the rapid pace of technological development, the industry is capital intensive. Growth and development rely heavily on an expanding revenue base. This can only come from full participation in established and developing global markets. Reliance upon domestic markets is not enough."

Yet after resisting the Brazilian government's demands for a decade, de Castro's Data General is selling technology for its Eclipse superminis to Cobra, the ailing government computer company. Other U.S. computer manufacturers are following suit.

Hewlett-Packard, in Brazil since 1967 with a wholly owned subsidiary to import and service the company's products, has just shifted its business into partnership with Iochpe, a Brazilian industrial and finance group. A new firm, Tesis, 100% Brazilian-owned, will make HP calculators and minicomputers under its own brand name.

"Only a few years ago HP refused to enter joint ventures, but now we have ones going in Mexico, China, Brazil and Korea," says a company executive. "In the past we felt, since we owned the technology, why share the profits? Then we found we couldn't get into those foreign markets any other way."

Harvard Professor Emeritus Raymond Vernon, a veteran analyst of international business, says of world technology markets: "Except for highly monopolistic situations, the buyer has a big advantage over the seller. Countries like Brazil and India can control the flow of technology across their borders and then systematically gain by buying technology cheaply."

Vernon draws an ominous parallel: "A century ago the multinationals were in plantation agriculture and electric power. Now they're all gone because their technology and management skills were absorbed by local peoples. The same thing is happening in other fields today, including computers."

This is why it makes little difference whether the dollar is cheap or dear. In this mighty clash between nationalism and free trade, nationalism seems to be winning. Where does this leave the U.S. dream of becoming high-technology supplier to the world? Rudely shattered. ■

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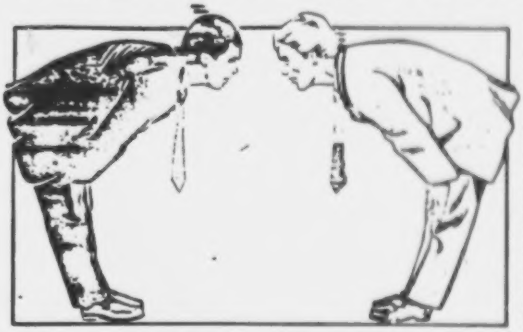
HIGH TECHNOLOGY



Clash of the titans

After steel, motor cars, consumer electronics and cheap microchips, Japan has begun to challenge American pre-eminence in the one industrial area the United States has long cherished as its own: high technology. The two are girding up for a trade war in high-tech that threatens to be bloodier than anything yet. Nicholas Valéry reports on the strengths and weaknesses of the two technological superpowers

The recent movie "Gung Ho" gets a lot of laughs out of the many misunderstandings that ensue when a Japanese car firm moves into a sad little town in Pennsylvania. Stereotypes abound: dedicated Japanese managers putting in double shifts, lazy American loudmouths slowing down the assembly line—with the locals winning a baseball match between the two sides only through brute force and intimidation.

All good clean fun. In real life, however, American workers—despite the popular myth—remain the most productive in the world (see the feature on the next page). In terms of real gross domestic product (GDP) generated per employed person, the United States outstrips all major industrial countries, Japan included (chart 1). The problem for Americans is that the rest of the world has been catching up. In the decade from the first oil shock to 1983, increases in annual productivity in the United States had been roughly a seventh of those of its major trading partners.

In the 1960s, American companies held all the technological high cards and dominated the world's markets for manufactured goods. The United States supplied over three-quarters of the television sets, half the motor cars and a quarter of the steel used around the world. Yet a mere two decades later, Japan had taken America's place as the dominant supplier of such products.

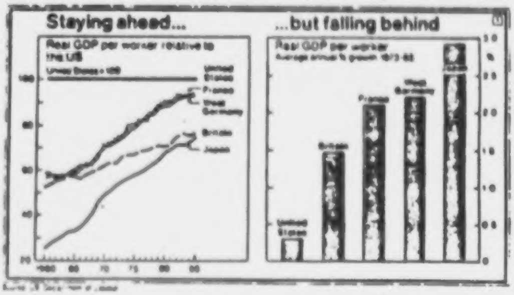
The agony for Americans does not end there. Over the past 25 years they have seen:

- Their share of world trade fall from 21% in 1960 to 14% in 1985.
- The American trade balance go from a surplus of $5 billion in 1960 to a deficit of $150 billion last year.
- More worryingly still, the country's trade balance in manufactured goods slip from a healthy surplus of $11 billion as recently as 1981 to a deficit of $32 billion last year—approaching 1% of America's total output.
- The volume of its manufacturing exports tumble 32% over the past five years—with every $1 billion of exports lost costing an estimated 25,000 American jobs.

Angry and confused, businessmen in the United States have had to stand by and watch as "smokestack" industry all around them has been snuffed out. Then came the unthinkable: if the Japanese could thrash them in mainstream manufacturing, would they give them a mauling in high technology, too?

By the beginning of the 1980s, it began to look as if they would. It became clear that the Ministry of International Trade and Industry (MITI) in Tokyo had "targeted" not just semiconductors and computers but all of America's high technology industries—from aerospace to synthetic materials—for a blitzkrieg attack.

Six years on, Japan has scored some



Power to the elbow

Americans work every bit as hard as (and often a lot harder than) the Japanese—and generate proportionately more wealth in the process. The average output of American workers last year was $36,800. The Japanese equivalent was $22,500 (at an average 1985 exchange rate of ¥220 to the dollar).

But labour productivity is only half the story. The amount of capital applied to a worker's elbow is crucial, too. The traditional definition of productivity (output per hour of all workers) makes it difficult to measure these inputs separately. True, the definition reflects all the factors that contribute to rising output—from advances in technology, better utilisation of capacity, improvements in the way production is organised and sharper management, to harder efforts by the workers themselves as well as the impact of changes in the amount of capital employed.

In 1983, the American Bureau of Labour Statistics introduced a yardstick called multifactor productivity. This shows the changes in the amount of capital as well as labour used in production. Reworking its data for 1950-83, the bureau found that multifactor productivity in the United States increased at an average annual rate of 1.7% for the period. As output per hour over the same period increased by an annual 2.5%, capital productivity inched up by only a modest 0.8% a year.

Overall, America's multifactor productivity has shown two distinct trends over the past 25 years. Until the first oil shock of 1973, the country experienced an annual 2% multifactor growth; then an annual average of only 0.1% from 1973 to 1981. The post-OPEC slowdown seems to have resulted from high interest rates keeping the brakes on capital spending while more people were having to work longer hours to hang on to their jobs.

How did the Japanese fare? The driving force behind the Japanese economy over the past 25 years has been the high growth in capital input. Mr Dale Jorgenson and his colleagues at Harvard University reckon it has been roughly double that in the United States. Growth rates in labour productivity have been much the same for the two countries. All told, the growth in Japanese productivity outstripped that in the United States until 1970, when productivity growth began to slow dramatically in Japan. Thereafter, with Vietnam behind it and two oil shocks ahead, the American economy flexed its muscles and coped more effectively. Then the competitive advantage started to move back in America's favour.

The interesting thing is what has happened since the last recession. Multifactor productivity in the United States has been running at an average of 5% a year, while the growth in labour productivity is now averaging nearly 4% a year. That means that productivity of capital employed is now growing at well over 6% a year.

Could this be the first signs of the productivity pay-off from the $80 billion that Detroit spent on new plant and equipment over the past half dozen years; the combined (additional) $180 billion invested by the airlines since deregulation, telecommunications firms since the AT&T consent decree and the Pentagon since President Reagan's defence build-up began in 1980? It looks remarkably like it.

notable hits. A group of American economists and engineers met for three days at Stanford University, California, last year to assess the damage*. They concluded that Japanese manufacturers were already ahead in consumer electronics, advanced materials and robotics, and were emerging as America's fiercest competitors in such lucrative areas as computers, telecommunications, home and office automation, biotechnology and medical instruments. "In other areas in which Americans still hold the lead, such as semiconductors and optoelectronics, American companies are hearing the footsteps of the Japanese", commented the Stanford economist Mr Daniel Okimoto.

How loud will those footsteps become? American industry may have been deaf in the past, but it certainly isn't any more. And never forget that Americans are a proud and energetic people. More to the point, they are prone to periodic bouts of honest self-reflection—as if, throughout their two centuries of nationhood, they have been impelled forward by a "kick up the backside" theory of history.

Once every couple of decades, America has received a short and painful blow to its self-esteem; Pearl Harbour, Sputnik, Vietnam are recent examples. What follows then is usually a brief and heart-searching debate along with a detailed analysis of the problem, then an awesome display of industrial muscle coupled with unexpected consensus between old adversaries—most notably between Congress, business and labour.

With its ceaseless shipments of cameras, cars, television sets, video recorders, photocopiers, computers and microchips, Japan unwittingly supplied the latest kick up the broad American buttocks. After witnessing Japanese exporters almost single-handedly reduce Pittsburgh's steel industry to a smouldering heap, drive Detroit into a ditch, butcher some of the weaker commodity microchip makers of Silicon Valley, and threaten America's remaining bastions of technological clout—aircraft and computers—then, and finally then, American lethargy ceased.

This survey tries to assess the strengths and weaknesses of the world's two technological superpowers. For if the past decade has seen some of the ugliest recrimination between Washington and Tokyo over trade issues generally, imagine what the coming decade must have in store. Henceforth, industrial competition between America and Japan is going to range fiercely along the high-tech frontier—where both countries take a special pride in their industrial skills and cherish sacred beliefs about their innate abilities.

The question that ultimately has to be answered is whether America is going to allow the Japanese to carry on nibbling away at its industrial base without let, hindrance or concession? Or are the Americans (as some bystanders have begun to suspect) "about to take the Japanese apart"?

With the gloves now off, which of the two technological heavyweights should one put some money on? In the blue corner, Yankee ingenuity? In the red, Japanese production savvy?

Copycat turns leader?

Is Japan still a technological free-loader—or has it become a pacesetter in high-tech?

America may still have the largest share of high technology exports, but Japan is catching up fast. It skipped smartly past West Germany to become the second largest supplier of high-tech goods in 1980 (chart 2 on next page). Only in three high-tech industries—communications and electronics, office automation, and ordnance—have American companies increased their market share.

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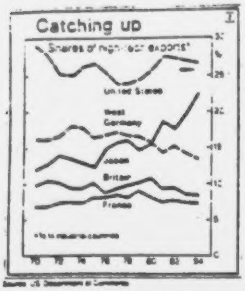
*Symposium on Economics and Technology held at Stanford University, March 17-19 1985. Now published as "The Positive Sum Strategy: Harnessing Technology for Economic Growth" by National Academy Press, Washington, DC.



Source: US Department of Commerce

The Japanese know they do not have a chance in fields that are either defence-related (for example, weapons, aircraft, satellites and avionics) or too dependent on imported energy or raw materials (like petrochemicals). But they see everything else as up for grabs. Even in lasers, software and computer-integrated engineering—where American pre-eminence was long thought unassailable—the Japanese have begun to make inroads.

Who would have thought it possible a decade ago? Of the 500 breakthroughs in technology considered seminal during the two decades between 1953 and 1973, only 5% (some 34 inventions) were made in Japan compared with 63% (315 inventions) in the United States. Despite its large, well-educated population, Japan has won only four Nobel prizes in science: American researchers have won 158. It is not hard to see why Japan has been considered more an imitator than innovator.

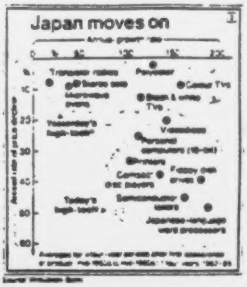
Stanford University's Mr Daniel Okimoto lists half a dozen reasons for Japan's lack of technological originality in the past:

- As an industrial latecomer, it has always been trying to catch up.
- The Japanese tendency towards group conformity has made it difficult to win a hearing at home for radical ideas.
- Research in Japanese universities is bureaucratic, starved of cash and dominated by old men.
- The venture-capital market is almost non-existent.
- Lifetime employment, along with a rigid seniority system, stifles innovation inside industry.
- And the traditional heavy gearing (high debt-to-equity ratio) of much of Japanese industry has made firms think twice about taking risks.

All these things—and more—have been true to some extent in the past; but all are also changing. The deregulation of Tokyo's financial markets, for instance, is forcing Japanese companies to reduce their levels of debt (see accompanying feature on next page). This, in turn, is making them more adventurous, while at the same time helping ferment a number of venture-capital funds.

Japan's "invisible" balance of technological trade (its receipts compared with payments for patent royalties, licences, etc) which had a ratio of 1:4? a couple of decades ago came within a whisker of being in balance last year. That said, Japan still buys its high-tech goods and knowhow predominantly in the West and sells them mainly to the developing world.

In certain industries, however, Japanese manufacturers have already started bumping their heads against the ceiling of current knowhow. There are no more high-tech secrets to be garnered from abroad in fibre optics for telecommunications, gallium arsenide memory chips for superfast computers, numerically-controlled machine tools and robots, and computer disk-drives, printers and magnetic storage media. In all these, Japan now leads the world. Today, Japanese-language word processors represent the cutting edge of high-tech in Japan—taking over the technological (but hardly export-leading) role that colour television played earlier (chart 3).



Although it is no longer quite the technological free-loader it was in the past, is Japan's new reputation as a pace-setter in high-tech justified? A new image has certainly emerged over the past few years of Japan as an invincible Goliath, capable of vanquishing any rival, whatever the field. Yesterday, the smokestack sectors. Today, high technology. Tomorrow, services. . . "Which is the 'real' Japan?" asks Mr Okimoto:

> Is it a technological imitator and industrial over-achiever? Or is Japan an astute learner and unbeatable colossus? Will Japan dislodge the United States from its current position of dominance in high technology as convincingly as it did in the smokestack sectors? Or has it reached the limits of its phenomenal postwar growth?

Japan is all these things and more. And to understand what the future holds, and whether America is up against a David or a Goliath, means looking closely at the frontiers of modern electronics. For the country that commands the three most crucial technologies of all—semiconductors, computing and communications—will most assuredly command the mightiest industrial bandwagon of the twenty-first century.

Made in the USA

Just as Japan has begun to muscle into high-tech, America has raised the technological stakes. The name of the game now is ultra-tech

High technology is an American invention. Despite the near meltdown at Three Mile Island, broken helicopters in the Iranian desert and recent disasters on the launch pad, Americans remain the supreme practitioners of this demanding and arcane art. And while the United States has racked up large deficits on its international trading account, it has enjoyed growing surpluses in its worldwide sales of high-tech goods. Or, rather, it did so until recently. Once again, blame the Japanese.

Five years ago, America sold the world $23.6 billion more technological widgets than it bought. That handy surplus had dwindled, says America's Department of Commerce, to a token $5 billion by 1984 (chart 7 on later page). Meanwhile, foreigners had grabbed three-quarters of the world's current $300 billion in high-tech trade. In the process, Japan has gone from being a small-time tinkerer in the 1960s to becoming (as in everything else) the Avis of high technology to America's Hertz.

Even so, trade in high-technology goods remains a crucial breadwinner for the United States. Since the mid-1960s, high-tech's share of American manufactured goods sold around the world has gone from a little over a quarter to close to a half.

Office automation is now America's most competitive high-tech industry as well as its biggest revenue-earner abroad. Selling its trading partners computers, copiers and word processors brought in

Crying all the way to the bank

One thing Americans have learned is that having the world's most productive labour force does not guarantee industrial competitiveness. At least three other things are needed. The first is to keep a lid on wages. The second concerns exchange rates. The third involves the return on capital employed. All three have been seen lately as spanners in the American works.

Take wages. During the ten years before 1973, real wages for American workers had increased steadily at an average rate of 2.6% a year. But ever since the first oil shock, real wages in the United States have stagnated. So American labour is becoming more competitive, yes?

Unfortunately no. When fringe benefits are included, hourly compensation for blue-collar workers in the United States has continued to rise. American labour has sensibly been taking raises less in cash than kind. Total compensation for American industrial workers—a modest $6.30 an hour in 1975—had climbed to $9.80 an hour by 1980 and to $12.40 by 1983.

Compared with Japan, hourly labour costs in America went from being on average a little over $3 more expensive in 1975 to becoming nearly $6 more so by 1983 (chart 4). So much for narrowing the $1,900 gap between making a motor car in Nagoya compared with Detroit.

Ah, yes, but hasn't the dollar tumbled dramatically? It has indeed—from a 1985 high of over Y260 to the dollar to a low this year of Y150 or so. In trade-weighted terms, that represents a drop for the dollar of 28% in 15 months. Meanwhile, the trade-weighted value of the yen has appreciated by over 40%.

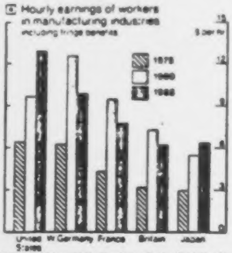
What about differences between America and Japan in terms of return on capital? Here things are actually better than most American businessmen imagine. True, real rates of return earned by American manufacturing assets in the 1960s were substantially higher than investments in financial instruments, while things were briefly the other way round during the early 1980s (chart 6). On the face of it, capital for buying equipment or building factories seems twice as expensive in America as in Japan.

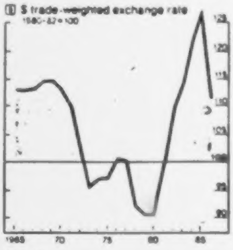
Today's most cited account comes from Mr George Hatsopoulos of Thermo Electron Corporation in Massachusetts. Comparing the cost of (non-financial) capital in the two countries between 1961 and 1983, Mr Hatsopoulos found real pre-tax rates ranged between 6% and 10% for Japanese firms and anything from 13% to 20% for their American counterparts.

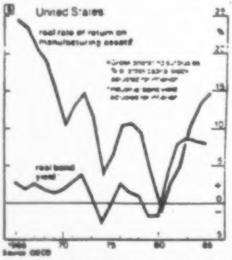
The conventional explanation for this difference is that Japanese firms are more highly geared (leveraged) and thus benefit because debt generally costs less than equity—interest payments being deducted from pre-tax profits, while dividends come out of taxed earnings.

Then there is Japan's two-tier interest rate structure, which is carefully regulated to favour business debt at the expense of consumer credit. Throw in a banking system that is bursting at the seams with yen being squirrelled away by housewives worried about school fees, rainy days and the ever-present threat of their husband's early (and often unpensioned) retirement. All of which, say American trade officials, adds up to a financial advantage that makes it tough for American firms to compete.

What is studiously ignored in the financial folklore about Japan Inc is the fact that, over the past decade, Japanese manufacturers have been getting out of debt as fast as decently possible (see the survey on corporate finance in *The Economist*, June 7 1986). The most compelling reason right now is because Tokyo's financial markets have joined the fashionable trend towards liberalisation. With old controls over the movement of capital going out of the window, Japanese interest rates are destined to become more volatile. So who wants to be highly geared when interest rates are rising or (worse) becoming less predictable?







Another thing Japanese manufacturers resent about some of these allegedly cheap industrial loans are the strings and hidden costs involved. The most punishing are the so-called "compensating balances" which a borrower has to deposit (at a considerably lower interest rate) with the bank offering the industrial loan. And so he has to borrow more money—at higher cost and with greater restrictions—than he actually needs.

Yet another thing that muddies the water is the way debt in Japanese balance sheets is grossly overstated by western standards. For one thing, the compensating balances, though they are actually deposits, are recorded as borrowings. Then there is the habit Japanese companies have of doing much of their business on credit, especially with suppliers and subsidiaries. This makes their accounts payable and receivable look huge—in fact, twice as large as in America.

Other factors inflating debt among at least the bigger Japanese companies are things like non-taxable reserves for special contingencies and (if they pay them) pensions. The last time figures were collected in Japan (in 1981), employees in large corporations with established retirement plans were divvying up 15-20% of their companies' capital through their pension contributions. All of which showed up in their corporate accounts as debt.

All that said, Japanese companies are on balance more highly geared than American corporations; and, overall, the cost of financing industry has been lower in Japan than in the United States. But at most only 20% lower, and nothing like the 50% lower claimed by lobbyists in America.

Technology's top ten

How high is the high in high-tech? Difficult to say. Most economists at least agree that high technology products embody an "above average" concentration of scientific and engineering skills. As far as the National Science Foundation in Washington is concerned, this means anything produced by organisations employing 25 or more scientists and engineers per 1,000 employees and spending over 3.5% of net sales on R&D.

The American Department of Commerce is a bit more scientific. Its definition of high-tech is derived from input-output analyses of the total R&D spent on a spectrum of individual products. Thus an aircraft gets credit for not only the R&D done in developing the airframe, but also the relevant contribution of the avionics supplier and even the tyre maker. Using this definition, high-tech industry is a ranking of the ten most "research-intensive" sectors, where the tenth has at least double the R&D intensity of manufacturing generally (table 1).

A laudable effort, but not without criticism. First, such a definition focuses entirely on products, ignoring the booming business in high-tech processes—and, increasingly, high-tech services as well. Second, it favours systems (that is, collections of interdependent components) over individual widgets, as well as products manufactured by large companies rather than small firms.

Third, because the data come of necessity from broad industrial categories, anomalies crop up—like cuckoo clocks being labelled high-tech because they fall within the eighth-ranking group, professional instruments.

Fourth, and perhaps most damning, the Commerce Department's definition is based on Standard Industrial Classification (SIC) codes—many of which have been rendered irrelevant by technological changes that have occurred since the SIC codes were last overhauled in 1972.

Table 1: Product range

	HIGH-TECH SECTOR	EXAMPLES OF PRODUCTS
1	Missiles and spacecraft	Rocket engines, satellites and parts
2	Electronics and telecoms	Telephone and telegraph apparatus, radio and tv receiving and broadcast equipment, telecoms equipment, sonar and other instruments, semiconductors, tape recorders
3	Aircraft and parts	Commercial aircraft, fighters, bombers, helicopters, aircraft engines, parts
4	Office automation	Computers, input-output devices, storage devices, desk calculators, duplicating machines, parts
5	Ordnance and accessories	Non-military arms, hunting and sporting ammunition, blasting and percussion caps
6	Drugs and medicines	Vitamins, antibiotics, hormones, vaccines
7	Inorganic chemicals	Nitrogen, sodium hydroxide, rare gases, inorganic pigments, radioactive isotopes and compounds, special nuclear materials
8	Professional and scientific instruments	Industrial process controls, optical instruments and lenses, navigational instruments, medical instruments, photographic equipment
9	Engines, turbines and parts	Generator sets, diesel engines, non-automotive petrol engines, gas turbines, water turbines
10	Plastics, rubber and synthetic fibres	Various chemicals derived from condensation, polycondensation, polyaddition, polymerisation and copolymerisation: synthetic resins and fibres

$20 billion in 1984. Along with aircraft, electronics and professional instruments, these "big four" account for more than three-quarters of the United States' exports of high technology (table 2). Despite the popular myth, America exports only modest amounts of missiles and aerospace products. But fears that foreigners may eventually storm even the high frontier of aerospace keep Washington officials awake at night.

Of the ten industrial sectors designated high-tech (see feature above), America has managed to increase its share of the global market in only two: office automation and electronics. For which, it should thank the likes of IBM, Hewlett-Packard, Digital Equipment, Xerox, ITT, RCA, General Electric, Texas Instruments and a host of brainy technological-based businesses scattered around the West Coast, Rockies, Sunbelt, Mid-Atlantic and New England.

A common cry in Washington is that this "narrowing" of America's high-tech base is one of the most disturbing problems facing the United States today. Others see this trend as more or less inevitable—and perhaps even to be encouraged. Trade ministers in Western Europe, for instance, only wish they had such "problems"; Japanese bureaucrats are doing all they can to create similar "problems" back home.

The reason is simple. These so-called "problems" concern a focusing of all the underlying technologies that have come to drive the computing, office automation and communications industries. All three provide the tools for handling information; and information—its collation, storage, processing, transmission and use elsewhere—will, quite literally, be the oil of the twenty-first century (see the survey on information technology in *The Economist*, July 12 1986).

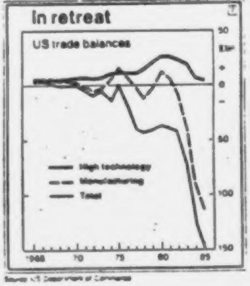
All that noisy jostling going on right now between the IBMs, Xeroxes and AT&Ts of the corporate world is merely the

Table 2: High-tech exports in 1984

High-tech sector	American exports		Others' exports*	
	Value	% of total	Value	% of total
Office automation	$19.7bn	22.4	$6.5bn	14.5
Electronics & telecoms	$14.4bn	22.0	$53.8bn	29.4
Aircraft and parts	$13.5bn	20.7	$15.4bn	8.4
Profess'l instruments	$7.2bn	11.0	$27.0bn	14.7
Plastics, rubber, etc	$4.4bn	6.7	$26.5bn	14.5
Inorganic chemicals	$3.5bn	5.4	$10.9bn	6.0
Engines and turbines	$3.2bn	4.9	$10.7bn	5.9
Drugs and medicines	$2.7bn	4.1	$10.7bn	5.9
Missiles and spacecraft	$1.0bn	1.5	$0.6bn	0.3
Ordnance	$0.8bn	1.3	$0.7bn	0.4

*Of the 14 other countries (apart from America) exporting high-tech goods, France, West Germany, Japan and Britain accounted for three-quarters of total trade.
Source: US Department of Commerce

In retreat



Source: US Department of Commerce

clatter of these three industrial sectors (each with its own distinctive style of manufacturing, procurement and customer support) being forged together by their underlying technologies into a single, ultra-tech activity called information services.

Yes, beyond high-tech in the industrial spectrum lies ultra-tech—today a mere multi-billion-dollar stripling of a business but by the year 2000 potentially a trillion-dollar leviathan. As such, ultra-tech alone will come to dwarf all manufacturing sectors before the century is out. America is well on the way to making that happen. A lap or two behind, Japan at least is getting up speed. Europe is barely in the race.

Chips with everything

Gone are the days when American semiconductor firms short-sightedly sold their licences and knowhow to Japanese microchip makers

America's electronics firms have maintained their global leadership in all branches of their business save one. They kissed goodbye to consumer electronics (television, hi-fi, video recorders, etc) as customers across the country voted with their pockets for shiny boxes with flashing lights and labels like Panasonic, Technics, JVC and Sony.

The American electronics industry came close to allowing much the same to happen in microchips. In 1982, Silicon Valley took a caning when the Japanese started flooding the market with cheap 64k RAMs (random-access memory chips capable of storing over 64,000 bits of computer data). Most beat a hasty retreat up or out of the market.

From having a dozen mass producers of dynamic-RAMs in 1980, only five American chip makers were still in the high-volume memory business by 1983. Today, there are effectively only two or three with the capacity to produce the latest generation of memory chips (1 megabit RAMs) in anything like economic volumes. Meanwhile, the six Japanese firms that plunged into the memory-chip business back in the early 1970s are still around—and now have a 70% share of the dynamic-RAM market in America.

Microchips have been the engine powering Japan's drive into high-tech generally. But before it could join the microchip generation, Japan had to find a way of disseminating this vital American technology throughout its fledgling semiconductor industry. The trick adopted was, first, to protect the home market, and then to bully abler firms into joining government-sponsored research schemes—one run by the Japanese telephone authority NTT and the other by the Ministry of International Trade and Industry—to develop the knowhow for making their own very large-scale integrated (VLSI) circuits.

Next, by "blessing" VLSI as the wave of the future and crucial to Japan's survival, the government triggered a scramble among the country's electronics firms (encouraged by their long-term investment banks) to build VLSI plants. The net result was massive over-capacity (first in 64k RAMs and then in 256k versions), abundant local supply for the domestic consumer electronics makers and an impelling urgency to export (or dump) surplus microchips abroad.

This targeting ploy had been tried before. Japanese manufacturers found it worked moderately well with steel, much better with motorcycles, better still with consumer electronics and best of all with semiconductors. The only requirement was a steeply falling "learning curve" (that is, rapidly reducing unit costs as production volume builds up and manufacturers learn how to squeeze waste out of the process).

The trick was simply to devise a forward-pricing strategy that allowed Japanese manufacturers to capture all the new growth that their below-cost pricing created in export markets, while underwriting the negative cashflow by cross-subsidies and higher prices back home.

The Americans finally lost their patience when the Japanese tried to do a repeat performance with pricier memory chips called EPROMs. The price fell from $17 each when the Japanese first entered the American market with their EPROM chips early in 1985 to less than $4 six months later. Intel, National Semiconductor and Advanced Micro Devices promptly filed a joint petition, accusing the Japanese of dumping EPROMs on the American market at below their manufacturing costs in Japan (then estimated to be $6.30 apiece). The issue is currently being used by Washington as a battering ram to breach the wall Japan has erected around its own $6 billion semiconductor market back home.

For America, this get-tough policy has come only just in time. Japan now enjoys a 27% share (to America's 64%) of the world's $42 billion semiconductor market. And while cut-throat competition may make memory chips a loss-leader, acquiring the technology for producing RAMs has given Japan's microcircuit makers a leg-up in getting to grips with more complex semiconductors used in computer graphics, communications and video equipment.

So far, however, it has not helped Japanese chip makers to loosen the stranglehold that American semiconductor firms have on the lucrative microprocessor business. Where 256k RAMs have become commodity products that sell wholesale for $1 or so each, 32-bit microprocessors from the likes of Motorola, Intel, National Semiconductor, Texas Instruments, AT&T and Zilog cost hundreds of dollars apiece. Between them, these six American chip makers control 90% of the world market for the latest generation of microprocessors, leaving just 10% for the rest of the American semiconductor industry, Europe and Japan.

Fortunately for the Americans, micro-

Street map for a microchip circuit

processors are not like memory chips. Being literally a "computer-on-a-chip", they are vastly more complex and cannot be designed in any routine manner. Sweat, insight and inspiration are needed every step of the way. And they have to be designed with their software applications in mind. Americans have been doing this longer, and are better at it, than anyone else.

More to the point, American firms are not parting with their patents as readily as they did in the past. Hitachi has been trying (with little luck) to persuade Motorola to sell it a licence for making its advanced 68020 microprocessor. Meanwhile, Japan's leading electronics firm, NEC, is having to defend itself in the American courts for infringing one of Intel's microprocessor patents.

With America's new, stricter copyright laws making it difficult to imitate American designs, Japanese chip makers are being shut out of all the major markets for microprocessors. Fujitsu, Matsushita, Mitsubishi and Toshiba are all gambling on a microprocessor design called TRON developed at the University of Tokyo. But nobody, least of all NEC or Hitachi, holds out much hope for the TRON design winning a big enough share of the market in its own right to be economic—at least, not until the mid-1990s. And, by then, Silicon Valley will have upped the technological stakes again.

When, late at night, the conversation gets down to *honne* (brass tacks), even Japan's ablest microchip wizards despair at ever matching Silicon Valley's mix of entrepreneurial and innovative flair. "Japan is powerful in only one sub-field of a single application of semiconductors tied to a specific line of products", bemoans Mr Atsushi Asada of Sharp Corporation.

Calculus of competition

Aping IBM has given Japan's computer makers a toe-hold in the market—but largely on Big Blue's terms

America's response to Japan's challenge in microchips is being repeated in computers. Here, Japan's specialty has been making workalike copies of IBM's big office machines (mainframes). The most one can say about these "plug-compatible" computers is that they have managed to prevent IBM from swamping the Japanese home market completely. Big Blue has to put up with being number two in Japan. Overall, however, Japanese compatibles have had only a marginal impact on the $150 billion computer business world-wide.

American manufacturers have established an almost impregnable position in mainframes and minicomputers—the stuff of corporate sales and accounting departments. And in the push to put a microcomputer on every desk, a handful of American firms (IBM, Compaq, Apple, Atari and Commodore) have been feeding the market a feast of cleverer, faster and (in many cases) cheaper machines that have left Japan's "IBMulators" nibbling on the leftovers of yesterday's lunch. In the personal-computer market, the IBM clone makers having the most impact come mainly from low-cost South Korea and Taiwan rather than Japan.

Meanwhile, in developing the programs that make computers tick, American software engineers have been every bit as clever as their chip-designing colleagues in Silicon Valley. In the process, they have increased their share of the world's software market (worth $40 billion a year) from under 65% a decade ago to over 75% today.

All this does not mean Japan's computer industry is a write-off. Its component suppliers have quietly established a significant position for themselves in the United States and elsewhere. In personal computers, for instance, Japanese machines account for less than 2% of the $14 billion annual sales of PCs in America. But Japanese components and peripherals (chips, disk-drives, keyboards, monitors, printers, etc) account for nearly 30% of the market's wholesale value.

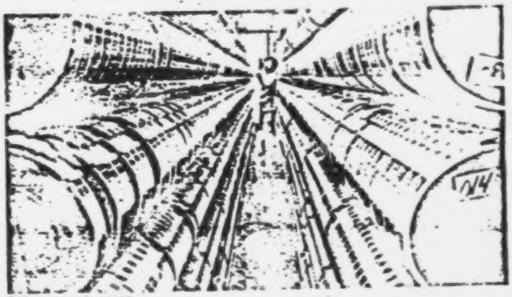
Most of Japan's computer makers came a cropper by riding a bit too blindly on IBM's coat-tails. Lacking the home-grown programming skills, Fujitsu, Hitachi and Mitsubishi made their computers imitate IBM's so they could sell cheaper versions to customers who were already using IBM machines equipped with the necessary software. That worked well until the slumbering giant woke up.

Then, in 1979, IBM introduced its 4300 series computers at a price that shook not just rival Japanese makers but other American suppliers too. Since then, IBM's aggressive price-cutting and frequent model changes have made life tough for the plug-compatible trade.

Not only is IBM automating vigorously (the company is spending $15 billion over the next four years to achieve lower production costs than anyone in Asia), but it has also begun flexing its technological muscles. Its R&D expenditure is now running at $3.5 billion a year—more than all other computer manufacturers combined. Though for antitrust reasons it will never say so publicly, IBM is nevertheless determined to trample the plug-compatible makers down—both in the personal-computer end of the business as well as among its mainframe competitors.

One of the dodges being adopted is to incorporate more "microcode" in its computers' operating systems (the basic programs that manage a machine's internal housekeeping and support the customers' applications software). Used as an offensive weapon, microcode replaces parts of the computer's electrical circuitry, making it possible to change the whole character of a machine long after it has been installed at a customer's premises. The implication is that IBM can then sell products that can be continuously enhanced—something customers appreciate and will pay a premium for.

Starting with its 3081 series in 1981, IBM caught the competition off guard with a new internal structure called XA ("extended architecture") which allows customers to update their machines with packets of microcode whenever IBM decrees the market needs a shake-up. This



Software needs space

has thrown the plug-compatible makers on the defensive, forcing them to devote more of their development resources than they can afford to trying to anticipate IBM's next round of operating system changes and to try to match them with hurriedly engineered modifications to their hardware. That involves digging ever deeper into their profit margins.

America's other computer firms are also pushing this trend towards replacing hardware with software wherever possible. Writing and "debugging" the programs now accounts for 50-80% of their budgets for developing new computers. Two reasons, then, why American computer executives are smiling:

- At a stroke, the trend towards greater use of software helps neutralise the one great advantage their Japanese competitors have long possessed—namely, the ability to manufacture well-made mechanical components at a modest price.
- And it changes the business of manufacturing computers from being heavily capital-intensive to becoming more brain-intensive. The large pool of experienced programmers and diverse software firms in the United States puts the advantage firmly in American hands.

The Japanese response has been to launch another government-sponsored scheme, this time to help the country's computer makers invent "intelligent" machines for tomorrow. The ten-year fifth-generation project, based largely on "dataflow" concepts pioneered at Massachusetts Institute of Technology, will have cost $450m by the time it is completed in 1992. The aim is to create computers able to infer answers from rough information presented to them visually or orally. Even Japanese scientists working on the project are not sure whether such goals are realistic.

The Americans are not leaving anything to chance. Congress has been persuaded to relax the antitrust rules so that rival manufacturers can collaborate on advanced research without running foul of the law. Two of the first collaborative research institutions to spring up aim to match any challenge the Japanese might offer in computing, software and components for the 1990s. In one, the Semiconductor Research Corporation, 13 microchip companies have clubbed together to form a non-profit consortium for supporting research on advanced integrated circuits at American universities. The consortium is now doling out $35m a year to designers of tomorrow's microchips.

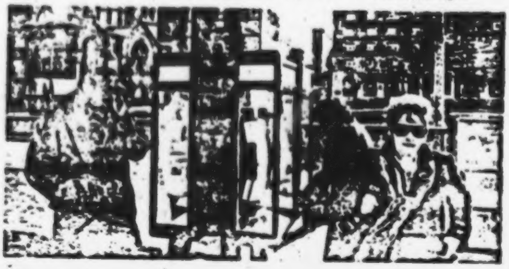
The other institution, the Microelectronics and Computer Technology Corporation (MCC), is an interesting experiment in its own right. Set up as a joint venture in 1983 by initially ten (now 21) rival American computer and semiconductor companies, MCC has 250 scientists carrying out research at its headquarters in Austin, Texas, to the tune of $75m a year. What is for sure, says Mr Bobby Inman, MCC's chief executive and former deputy director of the CIA, "MCC wouldn't have occurred except for MITI."

But the most orchestrated response of all to the Japanese challenge in computing comes not from IBM, Silicon Valley or collaborative consortia of American chip makers and computer firms. Though it is rarely in the public headlines, the Pentagon has been pouring barrels of cash into computing. Its Defence Advanced Research Projects Agency (DARPA) in Washington has been playing busy midwife to some of the most exotic technology of all for computers, communications and electronic equipment generally.

Its VHSIC (very high-speed integrated circuit) project alone has pumped $300m over the past five years into advanced methods for making the superchips needed for radar, missiles, code-breaking and futuristic computers. Also earmarked for DARPA is a reported $1 billion for sponsoring a range of supercomputers which, say insiders, "will outperform anything the Japanese can develop under their super-speed computing project or their fifth-generation programme."

At least a dozen "fifth-generation bashers" have surfaced as research projects around the United States, mainly in university laboratories, but also in small start-up companies founded by academics, entrepreneurs and engineering emigrés from the mainframe computer industry. The latest supercomputer to go public (the prototype was shipped last year to the American navy) is a cluster of boxes a yard square capable of calculating over a billion instructions per second (the Japanese government hopes to have a similar greyhound of a computer by 1992). The group that built it spun off mainly from nearby Massachusetts Institute of Technology to form their own company, Thinking Machines. The firm is now taking orders for a bigger brother with four times the processing power.

If only a handful of the score or so of American groups building advanced computers survives, the United States is going to enlarge its existing technology base in computing over the next decade by as much new engineering talent as its rivals have in totality. And that, not least for the Japanese, is a sobering thought.



Reach out and crush someone

Even more than breakthroughs in telecommunications technology, America's new deregulated freedom to plug in, switch on and sell an information service is breeding a whole new generation of infopreneurs

Americans complain about it, but if truth be told they still have the best and cheapest telephone system in the world. Japan's is a good one too—about as good as the Bell System was in the late 1960s. Which means it is reliable and cheap when making calls within the country, but not particularly good at performing electronic tricks like automatic call-forwarding, call-waiting, short-code dialling, credit-card billing, conference calling—all things Bell users take for granted today.

Americans also take for granted the choice of being able to dial long-distance numbers using alternative carriers who offer cheaper rates. Liberating the phone system from the state monopoly's clutches (so customers may choose what they want instead of what they are given) has barely begun in Japan.

The United States is the world's dominant supplier as well as its most prolific user of telephone equipment. The global market, worth $57 billion in 1982, is expected to grow to $[illegible] billion by [illegible]. American manufacturers have 42% of it, Japanese firms [illegible]. But that has not prevented Japan from becoming a major exporter of telecoms products. It now sells well over $1 billion worth of telephone equipment abroad, a quarter of it even to the United States. How did that happen?

The main reason is the size of the American market itself. Though the American share of the global telecoms business is five times bigger than Japan's, practically all of it is at home. Some 90% of the domestic market is controlled by the mighty American Telephone and Telegraph ("Ma Bell"). GTE has 10% of the American market, while ITT has traditionally sold its telephone equipment almost exclusively abroad.

Until the deregulation of the American phone system in the wake of AT&T's 1982 consent decree, Ma Bell's manufacturing arm (Western Electric) directed its entire production effort at meeting just the needs of the various Bell phone companies around the country. It got all its inventions and designs from the legendary Bell Laboratories in New Jersey, and neither imported nor exported a single transistor.

Bell Labs has been responsible for a blizzard of innovations (transistor, laser, stored-program control, optical fibres, etc) that have driven down the real cost of communications and raised the quality and availability of telephone service throughout the United States. But because of AT&T's preoccupation in the past with just the domestic market, the best of its technology has had little direct impact on the rest of the world. The door to export sales was thus left ajar for telecoms suppliers elsewhere—from Europe (Siemens, Ericsson, Thomson, GEC and Philips), Canada (Northern Telecom and Mitel) and Japan (NEC, Oki, Fujitsu and Hitachi).

American firms retain their dominant position in supplying switching and transmission equipment. But the Japanese have mounted a serious challenge based on their growing expertise in transmitting messages on the backs of light beams. Made out of cheap silica instead of costly copper, optical fibres can carry three times the telephone traffic of conventional cables, need few repeater stations to boost the signals and send them on their way, are immune to electrical interference and do not corrode like metal wires.

The early American lead in fibre optics, built up by Western Electric and Corning Glass, has been chipped away by scientists at NEC, Sumitomo and Japan's telephone authority (NTT). Apart from learning how to manufacture low-loss fibres, Japanese companies have become superb at making the minute lasers, light-emitting diodes and minuscule receivers used for projecting and catching the messages.

Hand in glove with fibre optics is the growing trend towards digital transmission—sending spoken or picture messages coded as the ones and zeros of computerspeak. The transmission part is easy, but optical switching has presented horrendous headaches and the competition here is fierce.

But American makers have used their knowhow to better commercial ends. In particular, digital transmission has been used to speed the growth in data traffic between big computer systems, especially those owned by airlines, banks, insurance companies and financial institutions. Here, the Federal Communications Commission has taken the initiative, by freeing America's telecommunications networks so anyone can plug in, switch on and sell an information service. Other countries—Britain and West Germany particularly—have been inexplicably making life as difficult as possible for their own infopreneurs.

The lesson has not been wasted on telecommunications mandarins in Japan. They have seen how getting the government off the back of the telephone companies in America has spurred a vibrant free-for-all in "value-added networking", creating numerous jobs in information services and giving local manufacturers a headstart in carving out a piece of a brand new high-tech business for themselves.

This new communications freedom—even more than the changes in digital switching and new transmission technologies—is one of the key driving forces behind the merger between computing, office automation and telecommunications that is beginning to take place within the United States. Last year, computer maker IBM absorbed Rolm, a leading manufacturer of digital private-branch exchanges. At the same time the telephone giant, AT&T, broadened its growing base in computing and office equipment by buying 25% of Olivetti in Italy. The leader of the office-automation pack, Xerox, is still suffering from a surfeit of exotic technology dreamed up by engineering wizards at its PARC laboratories in California.

Japan has no intention of being left behind. The government in Tokyo is pressing on with its plan to privatise as much of its telecommunications services as possible. And while the big names of the Japanese telecoms business (Fujitsu, Hitachi, NEC and Oki) may have deficiencies of their own, each is nevertheless a big name in computing too. And though smaller, all are more horizontally integrated than AT&T, IBM or Xerox.

Will Japan close the technological gap in telecoms with America? Quite possibly. But only through setting up shop in the United States. The reason concerns one missing ingredient, now as essential in telecoms as in computing: ingenious software. Just as Motorola and Texas Instruments have built semiconductor factories in Japan to learn the secrets of quality and cost control, Japanese firms will have to establish telecoms plants in the United States if they are to acquire the necessary software skills. NEC has now done so—for precisely that reason.

Getting smart

Manufacturing is also going high-tech, threatening to turn today's dedicated factories full of automation into relics of the past

Microchips, computers and telecoms equipment will be to the next quarter century what oil, steel and shipbuilding were to the years between Hiroshima and the Yom Kippur war. More than anything else, these three technologies will fuel the engine of economic growth in countries that learn to manage their "smart" machinery properly. This will hasten not so much the trend towards service jobs, but more the revitalisation of manufacturing itself.

Manufacturing? That grimy old metal-bashing business which the more prosperous have been quietly jettisoning for better-paid office jobs in the service sector? It is true that manufacturing jobs in all industrial countries (save Italy and Japan) have been shed continuously since 1973. In the United States, employment in manufacturing industry fell 2.5% last year to less than 20% of the civilian workforce.

But looking at jobs alone is misleading. In terms of manufacturing's contribution to GNP, for instance, little has changed. In fact, manufacturing's share of value added (at current prices) in America was 22% of GNP in both 1947 and 1984, and has wavered narrowly within the 20-25% band for close on 50 years. So much for de-industrialisation.

Manufacturing still means big business in anybody's book. It currently contributes $300 billion and 20m jobs to the American economy; about $350 billion (at today's exchange rate) and 15m jobs in Japan. But manufacturing is really a matter of how you define it. Traditional measures based on Standard Industrial

Classification codes continue to give the impression that making anything in a factory is going the same way as smokestack industry generally—up in smoke. Yet software engineering alone is an explosive new "manufacturing" industry that barely enters the American Treasury Department's calculations of growth, let alone its vision of what constitutes industry.

What is for sure is that the new battle in manufacturing competitiveness and productivity is going to be fought in the fields of process and design technology. Here is what Mr Daniel Roos of Massachusetts Institute of Technology has to say:

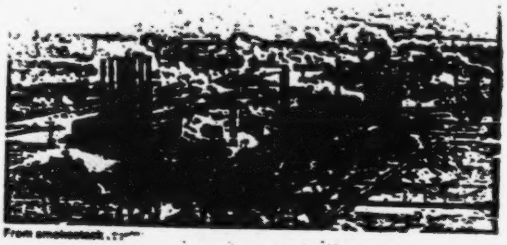
> Over the next 25 years, all over the world, semi-skilled labour—whether cheap or expensive—will rapidly give way to smart machinery as the key element of competitiveness. Neither cheap Korean labour nor expensive American labour is our real problem. Rather the challenge lies in rapidly introducing and perfecting the new generations of design and process equipment—and the complex social systems that must accompany them.

It does not require an MIT professor to explain why conventional manufacturing is limping out and new computerised forms of design and fabrication are muscling in. Using the favoured yardstick of productivity (return on investment after discounting for the current cost of money) even back-of-the-envelope calculations show only two factors really count. Energy costs are irrelevant, being typically 3-4% of factory costs. Much the same is true for labour, which now accounts for only 5-15% of total costs.

"The only significant, and controllable, factors are material costs and production volume", preaches Dr Bruce Merrifield of the American Department of Commerce. Thus, with roughly 30% of material costs being in inventory, a "just-in-time" delivery system (like the Japanese *kanban* method for supplying components to motor manufacturers) could improve the real return on investment by as much as 15%.

Getting manufacturing volumes right is trickier. Here high technology is making the whole notion of the special-purpose factory—with its automated equipment purring smoothly along as it churns out millions of identical parts all made to the same high standard of precision—a relic of the smokestack past. The marketplace is much more competitive today, no longer accepting the 10-12 year product life cycles needed to justify the investment of such dedicated plants. The pace of technological change is demanding that manufactured goods be replaced every four or five years: in consumer electronics, every two or three years.

The Japanese factory devoted solely to turning out 10,000 video recorders a day with a handful of operators is the end of the line—not quite yet, but destined shortly to become, a magnificent anachronism and epitaph to the age of mass production. It was a brief and grimy era, spanning just the single lifetime from Henry Ford to Soichiro Toyoda. To take its place, a whole new concept of manufacturing is being hustled out of the laboratory and on to the factory floor. This is the final melding of microchips, computers, software, sensors and telecoms to become in themselves the cutting tools of manufacturing industry.



From smokestack ...

... to robots ...

The retooling of America

Flexible make-anything factories are beginning to sprout across America, bringing back jobs that had slipped offshore

American engineers call it CIM. Computer-integrated manufacturing—hurried into the workplace by a kind of Caesarian section—has arrived before managers have had a chance to find out what they really want or are able to handle. The trouble—and there have been plenty of teething troubles—is that CIM has a grown-up job to do right now. To corporate America, it is the one remaining way of using the country's still considerable clout in high technology to claw back some of the manufacturing advantage Japan has gained through heavy investment, hard work and scrupulous attention to detail.

American companies began pouring big money into high-tech manufacturing around 1980. All told, firms in the United States spent less than $7 billion that year on computerised automation. Today they are spending annually $16 billion, mostly on more sophisticated CIM equipment. By 1990, investment in computer-integrated manufacturing will have doubled to $30 billion or more, forecasts Dataquest of San Jose, California.

General Motors has spent no less than $40 billion over the past five years on factories of the future. Even its suppliers are being hooked into GM's vast computerised information net, allowing them to swap data with the giant motor maker as a first step towards integrating them wholly within its CIM environment. IBM has been spending $3 billion a year on computerising its manufacturing processes. In so doing, it has been able to bring numerous jobs, previously done offshore, back into the United States. Pleased with the results so far, IBM has raised its investment in CIM to an annual $4 billion.

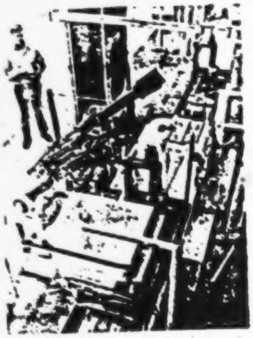
The heart of a CIM plant is a flexible manufacturing shop which can run 24 hours a day, but which is capable of being retooled in minutes rather than days, and able to turn out hundreds of different products instead of being dedicated to just one line. The difference between the best of traditional automation (for example, Toyota's Corolla line in Nagoya) and the best of new style CIM plants (for example, General Electric's household-appliance centre in Kentucky) is that the former automates just the flow of material through the factory, while the latter automates the total flow of information needed for managing the enterprise—from ordering the materials to paying the wages and shipping the finished goods out of the front door.

The aim of CIM is not simply to reduce the amount of direct labour involved in manufacturing a product (only 5-15% of the cost). The real savings come instead from applying strict computer and communications controls to slash the amount of waste (typically 30% of the cost) through having up-to-the-minute information on tool wear, while minimising the handling, management and overhead charges (rarely less than 40%) by knowing precisely where items are at any instant during the manufacturing process. The net result is that a CIM factory has a much lower breakeven point than a highly automated conventional plant. The majority of the CIM plants now onstream in the United States break even at half the level of a conventional plant (typically 65-70% of full capacity). And because it does not have to operate flat out from the start to be efficient, a CIM plant makes it easier and cheaper to launch new products. That spells shorter life cycles—and hence more frequent (and more attractive) model updates.

That would be reason enough for enterprising high-tech companies to invest in CIM. But a number of American corporations are being encouraged for other, more strategic, reasons to integrate their computerised manufacturing processes. The Pentagon sees CIM as a nifty way of allowing manufacturing capacity to be sprinkled lightly across the land, instead of being concentrated heavily in targeted areas along the Ohio Valley, parts of Illinois and up through Michigan.

The generals also see CIM plants—with their rapid response and flexible, make-anything nature—as handy standby capacity ready to be instantly reprogrammed to meet the military surge of a national emergency. Apart from its costly military stockpiles, the Pentagon has to underwrite a good deal of redundant and idle capacity among America's defence contractors. That is a political luxury it can no longer afford.

Pressure from other parts of Washington is also helping to usher high-tech manufacturing into American factories. To government gurus like Dr Bruce Merrifield, the attraction of these flexible manufacturing plants is that they are ideal not just for industrial giants like General Electric, Westinghouse or IBM, but even more so for the tens of thousands of tiny workshops across the country. While Japan has two-thirds of its industrial output within the grasp of broad-based *keiretsu* manufacturing groups, American industry by contrast has always relied heavily on its 100,000 or so independent subcontracting firms. In metal working, for instance, 75% of the parts made in the United States are manufactured by small independent workshops in batches of 50 or less.



... to CIM

The American Commerce Department sees no antitrust reasons why smaller firms should not band together to share a flexible manufacturing centre, making spindles for washing machines one minute, wheel bearings the next, then switching to precision mounts for a microscope maker, crankshafts for diesel engines, microwave cavities for radar equipment, nose-cones for missiles and so on. This would reduce the investment risk for the individual firms, while providing a higher return for the CIM plant as a whole. It could also help rebuild much of the industrial base of rustbowl America.

Let the daisies grow

Bureaucratic guidance is still no match for a fertile economy where anything can take root and flower

Who, then, is better suited to life on the high road of technology—America or Japan? The answer is complicated by the way the two industrial superpowers have honed their separate skills in wholly separate ways (table 3). American technology is overwhelming in big systems, software, computing and aerospace. But nobody can touch Japan in the process technologies that underlie conventional manufacturing. American technology reaches out for the unknown; Japan's bends down to tend the commonplace.

The differences in style mirror the differences in ideals that the two peoples hold dear. The Japanese have a saying: "The nail that stands up will be hammered flat." The Americans say: "Let the daisies grow." So it is hardly surprising that American technology is individualistic, often erratic and always iconoclastic. Japan's, if anything, is pragmatic, geared primarily to problem-solving and hustled along by a herd-instinct.

To date, Japan's high-tech success has been almost exclusively with developments that were predictable—like packing more and more circuits into dynamic RAM chips, or making video recorders smarter and smaller. This is a result of having total mastery of the process technologies. While all the basic breakthroughs for making semiconductors—electron beam lithography, ion implantation, plasma etching, etc—came from the United States, Japanese firms improved the ideas step by step until their equipment was a match for anything made abroad.

By carrying out development continu-

Table 3: Balance of forces

Japanese strengths	American strengths
Applied research and development	Basic research
Incremental improvements	Breakthroughs and inventions
Commercial applications	Military applications
Process and production technology	New product design
Components	Systems integration
Hardware	Software
Predictable technologies	Less predictable technologies
Quality control	New functionalities
Miniaturisation	New architectural designs
Standardised, mass volume	Customisation

Source: "The Positive Sum Strategy", National Academy Press, Washington DC, 1986 ages in small incremental steps instead of the American way of great quantum leaps every decade or so. Japanese firms have been able to bombard customers with a barrage of new models offering yet better value, quality and reliability. American firms, by contrast, have traditionally made cosmetic improvements every few years, and then brought out complete model overhauls once a decade or so. That has made their products look long in the tooth, then suddenly change dramatically—often for the worse while design bugs and production wrinkles are sorted out.

American technology has also tended to be geared for use mainly at home (for example, telephone systems, motor cars). With its smaller domestic market, Japanese technology has been forced to look farther afield. The Stanford economist, Mr Daniel Okimoto, makes the point that though Japanese firms have excelled at technologies tied closely to commodities with huge export markets (for example, continuous casting in steel, emission-control for motor cars, optical coatings for camera lenses), lately they have begun to do well in technologies for domestic use too. Some examples include gamma interferon and Interleukin II in pharmaceuticals, digital switching and transmission in telecommunications. And with their breakthroughs in gallium arsenide semiconductors, optoelectronics, superceramics and composite materials, the Japanese have shown themselves selectively capable of innovating at the frontier of knowledge as well as anyone.

On the whole, however, Japanese firms have been less successful with technologies that are inherently complex, not particularly predictable and dependent upon ideas springing from basic research. Making jet engines is one such technology. Designing air-traffic-control radars is another. Developing computer-aided design and manufacturing systems is a third. And despite MITI's "targeting" of lasers as a technology to be conquered, little progress has been made here to date—because not enough basic research has been done in the necessary branch of physics.

Such incidents point to serious problems in Japan's educational system. While Japanese youngsters out-perform western school children in all meaningful tests of mathematics and science, their training stresses rote learning rather than critical analysis and creative synthesis. At university, their skills in problem-solving are enhanced at the expense of their abilities to conceptualise.

As faculty members, Japanese academics are civil servants unable to fraternise as paid consultants in industry during the summer vacation. So Japan has none of the cross-fertilisation between basic research and commercial development that characterises MIT and Route 128, Stanford and Silicon Valley and a hundred other campuses across America. Also, because all the leading universities in Japan are state-owned and run rigidly by a conservative central bureaucracy, it is difficult to allocate grants (by peer-review) to the most deserving researchers rather than the most senior.

In the days when Japan could storm the

Lift-off for the airborne economy

Forget about America's underground economy of do-it-yourselfers pushing hamburger carts, paint brushes and illicit drugs. Above the conventional economy, a star-spangled wealth launcher lifted off three or four years ago—to take advantage of the soaring power and plummeting cost of microchips, the breakup of the geriatric telephone monopoly, the chimera of President Reagan's space shield and, above all, the technological collision of computing, communications and office automation. Meet America's exciting new airborne economy.

The first thing to understand is that nobody is quite sure how well even America's conventional economy is performing, let alone its underground or overground components. The only items reported properly seem to be imports and unemployment. The trouble is that the economy is changing so fast—from old-fangled businesses based on metal bashing and carting things around to new-fangled ones that massage, transmit and memorise scraps of information. What is for sure, the leading economic indicators—those monthly headlines that send shockwaves around the world's financial markets—seriously underestimate some of the most important growth sectors within the United States.

Because the statistics have not kept pace with the way American business is becoming internationalised, computerised and more service-oriented, the picture the statisticians paint depicts an economic landscape of a decade or two ago. Here are some examples of lagging statistical response:

- Companies are classified by industrial sectors using definitions last updated in 1972.
- Twenty years after computers swept manual accounting into the dustbin, the first price index for computers has just been introduced—and is still incomplete. Where America's computing costs have been assumed to be fixed, henceforth they will be deemed to fall (as they have actually been doing) by at least 14% a year—adding nearly 1% to GNP.
- An archaic processing system for logging foreign trade, confronted with a 90% increase in imports over the past decade, is ignoring America's growth in foreign sales. A significant proportion (some say 15-20%) of American exports now goes unreported.
- Measures of family income, designed in an age when welfare was a dirty word, omit non-cash components such as company fringe benefits for professionals (pension rights, deferred income plans, health and life insurance, etc) and in-kind government assistance for the poor (food stamps, rent subsidies, etc).
- Poverty is still defined by consumption patterns of the mid-1950s, when a family of three spent a third of its income on food. The same food basket today costs a fifth the equivalent family's income.

Don't snigger. Despite budgetary cuts, the American statistical system is still one of the best in the world. Its only real weakness is that—employment figures aside—the statistics used for determining, say, GNP or growth tend to be by-products of non-statistical agencies (such as the Internal Revenue Service, the Customs Service, Medicare and the Department of Agriculture). As such, they are far from being as clean, complete or timely as the experts would like.

Consider some recent anomalies caused by the quickening pace of technological change. With 70% of Americans being employed in the service sector, you might be tempted to categorise the United States as essentially a service-based economy. It is. But you would not think so from the Standard Industrial Classification (SIC) used in generating the input-output tables for measuring GNP. This has 140 three-digit codes for manufacturing firms, only 66 for services. Moreover, since the SIC system was last revised in 1972, whole new business activities (for example, video rental, computer retailing, software retailing, discount broking, factory-owned retail outlets) have sprung up, while others have withered away.

Nuts and bolts, for instance, are in an SIC category all of their own, employing a grand total of just 46,000 people. Envelope makers, again with their own SIC category, provide fewer than 25,000 jobs. Yet one SIC code in the service sector alone, general medical and surgical hospitals, now covers some 2.3m people. Lots of high-tech service businesses—including computer stores and software publishers and manufacturers—do not even qualify for their own SIC codes yet.

There is no reason why all SIC categories should be the same size. But the imbalance exaggerates the importance of traditional manufacturing at the expense of services in the American economy. Above all, it allows whole sections of America's booming high-tech economy to go unreported.

Back to the future

A glimpse or two at the future will dispel any doubts about Yankee ingenuity as it probes the limits of tomorrow's technology. First, to Silicon Valley where Mr Alan Kay, refugee from such technological hotbeds as DARPA, Stanford, Xerox PARC and Atari, is nowadays visionary-at-large at Apple Computer. Building on the learning theories of John Dewey and Jean Piaget, Mr Kay is trying to create a "fantasy amplifier"—a computer with enough power to outrace the user's senses, enough memory to store library loads of reference material, and enough clever software to couple man's natural desire for exploring fantasies with his innate ability to learn from experiment.

The concept, called "Dynabook", combines the seductive power of both a video game and a graffiti artist's spray-can with the cultural resources of a library, museum, art gallery and concert hall combined. Difficult to make? You bet, especially if the whole gizmo has to fit in a package no bigger than a notepad and be cheap enough for every schoolkid to own.

Smalltalk is the computer language Mr Kay has developed to allow kids to converse with the fantasy amplifier. The rest of the ingredients are all technologically imaginable, just prohibitively expensive and unwieldy for the time being. But a decade ago the first personal computer was just being built at considerable expense. Its functional equivalent today costs less than $50. Still only in his mid-40s, Mr Kay has ample time to put a Dynabook in the hands of millions of youngsters with open minds and a sense of wonder still intact.

Next, meet Mr Ted Nelson, gadfly, prophet and self-confessed computer crackpot, with a lifetime's obsession wrapped up in an enormous program called (after Coleridge's unfinished poem) Xanadu. Boon or boondoggle, nobody is quite sure. But the giant piece of software for steering one's own thought processes (including alternative paths, mental backtracks and intellectual leaps) is hardly lacking in ambition or vision.

Conceived originally by Mr Nelson when a student at Harvard as simply a note-keeping program for preserving his every thought, Xanadu has evolved into a total literary process: creating ideas; organising the thoughts, with traces showing backtracks, alternative versions and jumps to cross-referenced documents; manipulating the text; publishing the results; and logging a share of the royalties to every other author cited.

Every document in Xanadu's database has links to its intellectual antecedents and to others covering related topics. The linked references work like footnotes, except that Xanadu offers an electronic "window" through which they can be accessed there and then. Because the whole process works in a non-sequential way, the inventor calls the output "hypertext".

Mr Nelson looks forward to the day when anybody can create what he or she wants—from recipes to research papers, sonnets to songs—and put it into Xanadu's database and quote or cite anybody else. Royalties and sub-royalties, monitored automatically by the host computer, would be paid according to the amount of time a user was on-line and reading a specific document. It sounds pretty wild at the moment, but hypertext could be commonplace before the century is out.

industrial heights with foreign licences, homegrown development and production excellence, the inadequacies of its educational system and academic research hardly mattered. But such shortcomings are becoming increasingly a problem as high-tech competition intensifies.

Nor can Japan call on its little firms to provide the invigorating fillip of innovation such enterprises provide in the United States. And with their lifetime employment practices, Japan's big technology-based corporations rarely get a chance to attract high-flying talent from outside. Technological diffusion between small firms and large corporations, and between companies generally as engineers swap jobs, is one of the more invigorating forces for innovation in the United States.

Nor, also, is there an adequate way in Japan for financing risky innovation outside the big corporations. Since 1978, American equity markets have raised $8 billion for start-ups in electronics alone and a further $3.3 billion for new biotech companies. Over the same period, Japan's venture-capital investments in high-tech have totalled just $100m.

Lacking all these things, the Japanese have sought a substitute. This is one of the main reasons for MITI's special emphasis on collaborative research projects—as in VLSI or fifth-generation computers. To Mr Gary Saxonhouse of the University of Michigan, Japan's lauded industrial policies are little more than a substitute for the ingredients that American companies enjoy from their vibrant capital and labour markets.

As for MITI's infamous industrial targeting, many Japanese (as well as foreigners) have long doubted its effectiveness and believe it is now wholly inappropriate anyway. All technologies have started moving simply too fast to wait upon the whim of bickering bureaucrats. It is not as though Japanese civil servants have shown themselves any better at picking industrial winners than officials elsewhere; and none has bettered the invisible hand of the marketplace.

Apart from possessing vastly greater resources of well-trained brains, more diverse and flexible forms of finance, and a bigger and more acquisitive domestic market, America has one final, decisive factor moving in its favour—the pace of innovation itself.

High-tech products tend to have two things in common: they fall in price rapidly as production builds up (they possess steep learning curves) and they get replaced fairly frequently (they have short life cycles). The trend in high-tech is towards things becoming steeper and shorter. So the competitive advantage of being first to market is going increasingly to outweigh almost everything else.

This spells an end to the traditional low-risk, low-cost approach that Japanese companies have used so successfully to date—coming in second with massive volume and forward prices after others have primed the market. Henceforth, Japanese firms are going to have to take the same technological risks—and pay the same financial penalties—as everyone else. And that puts the advantage decidedly on the side of Yankee ingenuity.

Mr. Walgren. In the same way, you indicate that the effort in implementing the President's Order will be, in your words, direct and substantial. Understanding the limitation of resources, obviously something measurable has to be committed to that, and one of our problems with Stevenson-Wydler is we never could find the measure of it. We put the principle of the obligation to spend effort on technology transfer in the laboratories, and yet it was largely said, oh, we were already doing that, or something to that effect.

I really wish particularly now to set out a new effort to facilitate collaboration between the laboratories and the state and local governments and universities and the private sector. The question would be could you detail what resources the Department is going to commit to making that happen to create an effort that we would properly describe as "direct and substantial"?

[Question and answer follow:]

QUESTION

I really wish particularly (as) we now set out (on) a new effort to facilitate collaboration between the laboratories and the state and local governments and universities and private sector, and the question would be could you detail what resources the Department is going to commit to making that happen to create an effort that we would properly describe as 'direct and substantial'?"

ANSWER

The Department is exploring different options of ensuring an adequate resource level to carry out these important functions.

In response to the priority placed on enhancing R&D cooperation between Federally-funded laboratories and the private sector by the Administration and the Congress Commerce is establishing an Office of Federal Technology Management under the Assistant Secretary for Productivity, Technology, and Innovation who in turn, reports to the Under Secretary for Economic Affairs. This Office will be the focal point for some of the collaboration activities you mentioned.

To be effective, P L. 99-502 requires delegation of authorities from the head of each agency to its laboratories. The Secretary of Commerce has made the initial delegation to the Under Secretary who has organized a Departmental Committee for Implementation. When the Department's laboratories develop their internal implementation plans and procedures, the Under Secretary will delegate operating responsibilities to them.

P.L 99-502 also assigns three Government-wide roles to Commerce. The first is to provide what can be called technical assistance to other agencies and their laboratories To this end, we are developing model cooperative R&D agreements that laboratories can use as a guide in specific situations Further we are nearing completion of a set of educational materials for laboratory managers and staffs on how to take advantage of the new legislation in managing technology. These materials are scheduled to be made available to the agencies and their laboratories in July.

The second Government-wide role involves reporting to the President and Congress on agency activities under the Act We have contacted the agencies with significant laboratory complexes, and are organizing an interagency implementation committee. One of the first things the committee will consider is the type of information that will be needed to produce a useful report In addition to helping with the report, considering this question now will concentrate attention on the range of actions that agencies need to take in the near future.

The third Government-wide role is for the National Bureau of Standards to provide administrative support to the Federal Laboratory Consortium (FLC). A memorandum of understanding has been completed between NBS and the FLC, the FLC has appointed a staff liaison officer, and FLC work is progressing

In addition, the Department is reviewing its activities under other statutes to make them most supportive of 99-502. For example, the new Office of Federal Technology Management will be responsible for the regulations under which all agencies license inventions they own, particularly those made by Federal employees. These requlations, and perhaps their underlying statutes will be reviewed for improvement opportunities. This Office is also investigating ways to improve commercial use of Federal technology other than inventions, such as computer software.

Mr. **Walgren**. I would like to ask you to comment further on that. I have to respond to the call to a vote on the floor. It will take ten minutes. Do you have ten minutes?

Mr. **Riggs**. Absolutely.

Mr. **Walgren**. All right. Then let's suspend and I will be right back.

[Recess.]

Mr. **Walgren**. Let us resume.

Let me reiterate the effort to ask you to measure the size of the problem that you think we are talking about with respect to the lack of careful attention by American managers to being taken advantage of in international joint ventures.

I would also like to underscore that you say in the testimony how important it is that Government-owned, Government-operated laboratories enter into cooperative R&D agreements. We have had one that we have been trying to promote for the last three years stemming from the President's Science Adviser's steel initiative, and I am sorry to say we were deferred one year and rescinded another and then unfunded in the next. So to put the meaning to the words, it would seem that that would fit almost hand in glove with that effort that you are making there.

Although that comes through the Department of Energy and might not be directly in your purview, I just want to raise the flag that there have been attempts in these directions before that have really not been met with receptivity.

You indicated that one instruction would be to encourage retention of ownership of federally funded technical data by the contractors involved. I would like to raise a concern about that in that some data certainly would best be disseminated through a library-type approach in which it isn't the ownership right of the information that really encourages its dissemination. How would you differentiate between data that might be more fully distributed if it were considered proprietary but the other very broad range of data that really might wind up less widely used if it were held in that framework?

Mr. **Riggs**. I think that when you talk about the dissemination of data, and particularly a lot of the data that is developed in government labs, one of the over-arching concerns centers on the national security aspect. Of course, the Executive Order acknowledges that over-arching concern.

I think there is another way of looking at this particular issue. It is the interest of those of us in the Department of Commerce, and I think increasingly now in the government itself to move as rapidly as possible into commercialization of federally funded R&D. One of the things that would help is obviously to let contractors to retain certain intellectual property that they have developed because there is a tremendous motive that is associated when one has ownership, when one has the ability to have proprietary interest in a particular item.

At the same time, I think your point is extremely well taken that there are other data which may have a greater value if they could be more widely disseminated, as you suggested, through a library-type system.

So what I am suggesting is that there are obviously competing interests on this particular issue. It is one that is going to have to be worked through, but I think that other than this over-arching concern about national security, I think that we in the Department of Commerce would be most interested in having the route taken that would best ensure the greatest commercialization. If that, in fact, would be one which allows the contractor to retain it in contrast to wider dissemination, then I think we would probably come down in favor of that.

As I said, the bottom line that we at the Department of Commerce are seeking is commercialization. We believe that commercialization is something that is not only good for American business but, frankly, very good for the American consumer.

[Question and answer follows:]

Question:

I would like to ask you if you couldn't try to measure what has happened in response to the 1980 effort to allow small businesses and universities to participate in patent incentives that, as I understand it, has been a matter of law since that time.

Answer:

I am pleased to state that all federal agency funding agreements now allow small business and non-profit contractors to elect title to inventions as provided by P.L. 96-517, as amended by P.L. 98-620 (The Act).

By leaving title to federally funded inventions in small business and non-profit organizations as provided by the Act, there has been a substantial positive impact on commercialization by such entities. This substantial positive impact I mention, is confirmed in an April, 1987 GAO report (attached). The report states that there has been:

a. increased invention reporting by small business and non-profit contractors;
b increased licensing of inventions by small business and non-profit contractors; and
c. increased bidding on government contracts by small business contractors.

Further, since businesses know that universities can take title to federally funded inventions, they are no longer concerned that their research efforts could be "contaminated" by federal funding with the possibility that a federal agency could assert title rights to resulting inventions. Accordingly, cooperative arrangements between universities receiving federal R&D funds and industry have grown 74 percent from $277 million in FY 1980 to $482 million in FY 1985 (in constant dollars). The GAO report also points out that while the influence of the Act alone on competitiveness is difficult to quantify, the overall effect of the change in federal policy has been positive. These facts lead us to believe that the Act has been an unqualified success in fostering the establishment of R&D cooperative agreements in turn which lead to commercialization of Federally-funded inventions.

The positive impact of the Act on commercialization has also been confirmed in a July, 1986 report published by the Association of American Univer-sities (AAU) entitled "Trends in Technology Transfer at Universities" (attached).

encouraged business sponsorship of their universities' research and have reduced their universities' administrative costs. The Public Law 98-620 amendment that removes licensing restrictions on nonprofit organizations will be significant for their universities' innovation efforts. Small business representatives stated that the title rights provisions have encouraged small businesses to bid on government contracts and to participate in the SBIR program.

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TRENDS IN TECHNOLOGY TRANSFER AT UNIVERSITIES

REPORT OF THE CLEARINGHOUSE ON UNIVERSITY-INDUSTRY RELATIONS

ASSOCIATION OF AMERICAN UNIVERSITIES
JULY 1986

AAU
Association of American Universities

President

June 1986

MEMORANDUM

From: Robert M. Rosenzweig

This report, "Trends in Technology Transfer at Universities", is the second report of the Association of American Universities' Clearinghouse on University-Industry Relations. The Clearinghouse was established in 1983 with the help of a grant from the Pew Memorial Trust with the purpose of providing all interested parties with information about university policies and practices relating to research collaboration between universities and industry.

The first report of the Clearinghouse, published in February 1985, addressed two issues of concern to universities: faculty conflict of interest, and the delay of publication of research results. That report illustrated how universities have adopted policies and procedures that address these and other related problems that accompany industry-sponsored research agreements.

In selecting a topic for the second report, the Clearinghouse focused on the activities of universities themselves rather than faculty members. In addition to permitting and sometimes facilitating industry-sponsored research, many universities are

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now taking steps to arrange for university-owned inventions to be developed and marketed. In some cases the university itself undertakes the development and marketing of the invention. In others, the university establishes either nonprofit or for-profit entities to perform similar functions.

This report describes the diverse approaches currently being taken by leading research universities, both philosophically and pragmatically, in forming and implementing the role of the university in technology transfer and licensing. All the institutions participating in this survey have given extensive consideration to the risks and benefits of technology transfer activities. As one might expect, the practices of the sampled institutions differ markedly and so do the reasons given for those practices.

The AAU hopes these materials will prove to be informative and useful.

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PART I - EXECUTIVE SUMMARY

This AAU report, Trends in Technology Transfer at Universities, is based on responses to a survey questionnaire in 1985. The questionnaire sought information regarding the technology transfer activities of universities, specifically:

- whether respondents had restructured their internal patent and licensing efforts in order to increase the number of inventions owned and successfully licensed by the university, and if so, the circumstances of the decision to do so and the results of such efforts;

- whether respondents had established an external entity to undertake technology transfer of university-owned inventions, such as a nonprofit foundation or a for-profit company, and if so, the circumstances of the decision to do so and the results of such endeavors.

The survey responses reported widespread changes in internal patent and licensing activities and corresponding increases in the number of invention disclosures provided by faculty to the university. The report explores circumstances that may have contributed to this trend, including:

- changes in federal patent policy relating to universities;
- a new approach to the public service role of universities which encourages technology transfer;
- growth of state economic development programs which provide incentives to universities to link university-

based technology with the business community;

- requests from faculty for aggressive technology transfer capabilities in the university and corresponding financial incentives to faculty for their inventions;
- reduced funds for research from other sources.

With regard to external foundations and companies to provide patent and licensing services and, in some cases, to provide funds or investors for further development and marketing of an invention, the survey results were inconclusive. Two problems with the survey information rendered the results unclear:

- few institutions reported such activities;
- those that did report undertaking such activities did not report the accomplishments and failures of these activities.

The text of the report discusses in depth the discernible trends in university technology transfer and the prospects for the future activities of universities in the commercialization of research results.

PART II - INTRODUCTION

A. Purpose of Report

The purpose of this report is to review the results of the second university survey conducted by the Clearinghouse on University-Industry Relations. The subject matter is the technology transfer activities of universities. The principal focus is the efforts of universities to promote development and marketing of university research results.

The first report of the Clearinghouse, University Policies and Procedures Regarding Conflict of Interest and Delay of Publication (February 1985), was based on university responses to questions regarding two issues growing out of university-industry research relationships: conflict of interest among researchers, and delay of publication of research results. Notwithstanding some differences among universities, the first survey demonstrated remarkable similarities among institutions in establishing policies and procedures regulating faculty conflict of interest and contractual delay of publication.

The first report concluded that there are dynamic forces operating both within and outside the university to encourage cooperation between universities and industry, especially in areas of new technology. Those considerations have directly affected the functions of the university itself, prompting many administrators of major research universities to consider seriously for the first time the proper role of the university in promoting the successful transfer of its technology from the laboratory to the marketplace.

The responses to the second survey differ dramatically from the first. Major research institutions have diverse policies and procedures concerning the extent of the university's role in the business of developing and marketing inventions. The responses indicate that many of these differences may be attributed to:

- differing philosophical approaches to business relationships;
- inexperience in business matters;
- available resources of the university;
- the cooperation and initiative of state and local governments in promoting innovation and new business;
- the differing interests and concerns of researchers.

These factors, and the responses of the universities surveyed, are the subject of this report.

B. Background

1. Overview

a. Divergent Goals of Universities and Businesses

Universities, like other owners of intellectual property, must protect their inventions. They do so through the federal system of patents or copyrights. If the invention is unsuitable for such protection, an owner of an invention may choose to keep the property secret, although many universities treat secrecy as an inappropriate practice. Once protected, a university seeks methods for perfecting, marketing, and manufacturing the invention. and eventually licenses it for a financial return. The method most frequently used is to negotiate a license agreement with an interested party who wishes to bring the invention to the marketplace. In exchange for the opportunity to use. manufacture, and sell the invention, the licensee pays royalties to the owner of the invention. Typically, the inventor is entitled to a portion of the royalties from the invention.

Unlike other owners of intellectual property, however, universities have been the object of a controversy concerning their role in promoting development of inventions resulting from university research, especially in "high technology" areas. The goals of entrepreneurs who take business risks to develop products and services for profit differ greatly from the teaching and research goals of universities. These differences are at the heart of the ethical and legal issues surrounding university-industry interaction.

Notwithstanding the considerable differences between the profit-making goals of the private sector and the scholarly and educational goals of universities, the two parties each have resources that are needed by the other. The university can accept the financial support provided by industry and the industrial sponsor can accept the university's concerns for quality and impartiality in its research. Thus the two can form a respectable and profitable research relationship. Many participants in these relationships, and others in government, believe that university-industry collaboration brings a benefit to both parties, and thereby to progress and innovation in the economy.

b. Additional Factors Pointing Toward Collaboration

Several other factors have contributed to the increasing expectation that universities should assist industry's application of new ideas. Those factors include:

- changes in federal patent laws relating to universities;
- promotion of university-industry interaction by state governments;
- university interest in enhancing the income flow from university-owned inventions;
- the interest of entrepreneurial faculty in opportunities to reap greater financial rewards from their research efforts;
- a greater willingness on the part of industry to adapt to university concerns in order to structure the sponsorship of research and licensing of the results.

Many universities have recently begun to expand their role in the commercialization of research results. Universities evaluate the activities relating to technology transfer by considering issues such as the appropriateness of such activities to the primary mission of the institution and the amount of risk involved in promoting business development and marketing of research results.

Although the universities surveyed have been successful in increasing the technology transferred from the university to the marketplace, few have also been able to become participants in the commercialization of their own technology.

e. Survey Methodology

The information offered and conclusions drawn in this report are based on the responses of institutions to a questionnaire. (The text of the questionnaire appears in Appendix A.) Some institutions invited to participate in the survey chose not to respond. Others answered only some of the questions or offered examples to illustrate an answer. (A list of the universities that responded to the survey appears in Appendix B). Thus the responses are not readily adaptable to standard methods of quantitative data analysis. Therefore, unlike the first report of the Clearinghouse, this report will not offer conclusions based on the percentage or number of universities undertaking certain technology transfer activities. Instead, this report offers a broad discussion of the trends among the universities that did participate in this survey, and sets forth the universities' own examples to provide greater insight into those activities.

2. Role of the Federal Government: Changes in Federal Patent Law

a. Description of the Changes in Federal Patent Law

In 1980, a significant change in the federal patent policy regarding inventions made with federal assistance was enacted. Public Law 96-517, the Patent and Trademark Amendments of 1980, provided that universities and small businesses could retain patent rights to inventions resulting from research conducted with federal funds.

The purpose of the change in the law was to facilitate the use of government-funded inventions as the basis for commercial products. Until the new law was enacted, only five percent of government-owned inventions had been utilized by business. 1/ Congress was concerned that this low utilization was partly the result of restrictive federal patent policies and the preference for non-exclusive licenses. Such licenses are perceived by entrepreneurs to be necessary to justify the risk and capital investment in development and marketing of inventions. By giving the university clear title to the invention and the financial incentive to promote its development, Congress hoped that research results from federally-funded research would no longer lie dormant. 2/

b. Results of the Change in Law

P.L. 96-517 and subsequent amendments enacted in 1984 (P.L. 98-620), appear to have had the intended result. This new patent policy has further contributed to a change in attitude by both universities and industry concerning cooperation on developing technology. In reporting the 1984 amendments to P.L. 96-517 to the House of Representatives, the Committee on Science and Technology stated:

> "These laws [P.L. 96-517 and P.L. 96-480, The Stevenson-Wydler Act, relating to promoting technological innovation within the government] and other events have made government research officials more sensitive to and more interested in cooperating with the private sector. Universities and small businesses have had incentive to promote inventions made under federal contract and more federal inventions have been the basis of commercial products." 3/

Many respondents to the Clearinghouse survey credit the new Federal patent law with providing the incentive for the university to establish an aggressive patent and licensing program. including the commercialization of inventions resulting from privately supported research. However. other respondents stated that Federal patent policy had no impact upon their patent and licensing efforts. This latter view was shared both by institutions that are pursuing an active program and those that are not.

One explanation for such a discrepancy is that the Federal patent law is only one of several factors that have influenced university decisions on the appropriateness of technology transfer activities.

First, the university may have been encouraged to pursue an aggressive patent and licensing policy because of interest in greater commercialization of research results by faculty researchers. Second, it is also possible that a statewide economic development program involving the university may have increased awareness among administrators concerning the university's patent and licensing efforts. Thirdly. the impetus for an aggressive technology transfer program could have been generated from an administrative office of the university rather than the office responsible for patent and licensing activities. In some cases, the Office of the President, in examining the relationship between the university and local industrial research, may have brought attention to the university's patent and licensing program.

In spite of these discrepancies. the fact that the Congress changed the Federal patent law to encourage universities to own and market federally-funded research results tends to validate an entrepreneurial approach by the university toward all research results it owns.

3. Role of State Governments: Changes in State and Local Development Efforts

a. General

Many state governments, facing the need to revitalize industry within their boundaries, have turned to universities in the state as centers of innovation and opportunity. The National Governors' Association stated this premise in its report Technology and Growth: State Initiatives in Technological Innovation (October 1983):

> "State governments are critically situated to encourage and facilitate the process of technological innovation...They support the vast majority of the nation's public institutions of higher education where most university research and development take place. They provide significant technical, management and financial assistance to new and existing technology-based firms from which innovations to the marketplace flow. Equally important, state governments are in a position to build the kind of partnerships with education and industry that stimulate innovation and help to ensure its continued vitality and

relevance." 4/

One trend that can be identified from the responses to the survey is that public universities tended to be involved in innovative technology transfer activities as a result of state economic development programs. In addition to state start-up funding for new research centers, the initiative for the university's activities is assumed by the state. In these cases, universities are one component of a state-wide strategy to undertake technology transfer activities.

b. Variations Among State Economic Development Programs

Some states have established cooperative centers among several universities in a single region of the state and require industry participants to provide funding to the center. Other states have grant programs for universities to establish their own programs. The initiative for a program may have come from the legislature, the governor's office or a task force appointed by the governor, or from the state office of economic development. Some programs focus on a single effort or industry, others disperse funds widely. Of course, state universities are an integral part of a state's resources to enhance its economy. In addition, most long-range state programs include the participation of private universities in the state.

c. Usefulness of State Economic Development Programs

The participation of the state government in efforts to promote collaboration between industry and universities is often an encouragement to both parties. Industry participation is increased by the state's commitment of funds. The university relies on the state as a buffer between it and industry demands. Many respondents to the survey stated that federal and state programs to promote collaborative research activities have also helped increase the number of inventions patented and licensed by the university.

d. Example: New Jersey

One example of a sweeping approach by a state to enhance its own economy is reflected in the _Report of the Governor's Commission on Science and Technology for the State of New Jersey_ (December 1983). The Commission's report sets out four support mechanisms to promote university-industry collaboration in the state. The Commission recommended the establishment of advanced technology centers to support equipment acquisition and research at the state's public and private higher education institutions. Industry would contribute to the centers through affiliates programs, membership fees, matching grants, and in-kind support.

The report also recommended a matching grant program awarded to individual researchers working in emerging technologies with commercial potential and a program of incubator facilities to provide low-cost space to new companies to be selected by the sponsoring university and to be financed by state-backed revenue bonds. Lastly, the Commission proposed a technology extension service, modeled after the Agriculture Extension Service, to accelerate application of new technology to industry.

The New Jersey Commission also selected technological fields to be targeted, and recommended the establishment of a state venture capital fund, new loan programs, and modifications of restrictions on investment and tax benefits of high technology investment. The Report also provided strategies for increased attention to education. training, and job development.

To date, the state has established five advanced technology centers with the help of a $90 million bond issue. The centers include the Center for Ceramics Research at the State University at Rutgers (which began with support from the National Science Foundation), the Hazardous Waste Center at the New Jersey Institute of Technology. and the Center on Biotechnology and Medicine jointly with Rutgers and the University of Medicine and Dentistry of New Jersey. In addition. the state has established a permanent New Jersey Commission on Science and Technology to further implement the report and to support science and technology in the state.

e. Example: Wisconsin

In 1983, the State of Wisconsin established the Technology Development Fund to provide funding for new technology projects. The University of Wisconsin established its Office of Industrial Research and Technology Transfer in that same year. The Office is financed in part by the Fund, and its purpose is to promote, facilitate, and develop cooperative research and development programs and to guide faculty in their pursuit of commercial development of inventions.

f. Other Examples

Other notable state economic development programs which established centers for research at universities are the Ben Franklin Partnership in Pennsylvania and the North Carolina Biotechnology Center in North Carolina.

4. Role of Universities

The survey responses showed that universities do not have a unified view of their role in technology development and its relationship to business. Most institutions stressed their commitment to education and the transmission of knowledge to the public domain. This principle was clearly stated by the Acting President of the University of Wisconsin in a letter accompanying the response to the survey, in which she stated that technology transfer activities "have been motivated by a sense of our responsibility to communicate knowledge to the broader scientific and technical communities, rather than as a source of additional research funding. Indeed our general experience has been that technology transfer is in this sense an expense rather than an income item." 5/

Other institutions characterize their activities as entrepreneurial. The President of the University of Utah, Chase N. Peterson, refers to that institution's activities as "academic capitalism", and reports that the institution is aggressive in its role as business facilitator for faculty and other entrepreneurs who wish to utilize the resources of the university to develop businesses from university research results. 6/ The University of Utah frequently takes an equity interest in new ventures to commercialize inventions resulting from research on campus.

As a result of the varying approaches of institutions to technology transfer, the types of activities they have undertaken cover a wide spectrum. Some universities had considered the formation of corporations or other arrangements which required the university to undertake financial risk based on the commercial success or failure of the developed products or services. These institutions have formed new enterprises based upon carefully considered recommendations and a subsequent business plan. Some have rejected such action. Others had not carefully considered such actions, but have rearranged the duties of personnel within the institution to direct more effort into patenting inventions.

Part III - Technology Transfer Conducted From Within the University

A. Background

The activities of a university to protect intellectual property and to market inventions successfully may be conducted by the university itself or on behalf of the university by an entity outside the institution's direct control. In order to determine how much of this activity is conducted inside versus outside, the survey asked respondents to describe their internal operations for patenting and licensing university-owned inventions, including their use of outside patent management firms for evaluating invention disclosures and filing patent applications. The survey asked: Does the university encourage faculty to disclose inventions; upon what basis does the institution distribute royalties; and has the university increased its efforts to promote the institution's patent and licensing program?

B. Results of Survey

1. Establishment of University Patent and Licensing Capability

a. General

Most of the universities responding to the survey have revised their patent policy within the last three years or are presently in the process of so doing. Recent revisions place greater emphasis on technology transfer. Techniques include identifying a single office within the university to be responsible for negotiating licenses with industry, and providing increased monetary and support services incentives to faculty to encourage invention disclosures. In most cases the revisions were undertaken at the recommendation of an advisory committee appointed by the president or a vice-president of the university consisting of faculty, staff, and administrators and reporting directly back to the president or the board of trustees of the university.

b. Example: University of Washington

For example, in 1981, the University of Washington formed a University Task Force on Technology Transfer to review policies and practices. Among other items, the Task Force recommended new policies to:

- reward faculty for research with commercial potential;
- revise patent policy in light of the federal patent law changes;
- provide greater royalties to the inventor's department for research;
- establish a new office to coordinate ventures with outside firms and the newly established Washington Research Foundation.

Further, the Task Force recommended the establishment of a standing committee to monitor this policy and its implementation.

The university adopted and implemented all of these recommendations and all patent and licensing matters are now the responsibility of the Office of Technology Transfer.

The University of Washington reported a dramatic increase in the output of their licensing program. In the first half of 1985, the university had received 75 invention disclosures as compared to 25 in each year between 1978 and 1982. The university also reported an increase in the number of licenses and the number of inventions being evaluated for commercial potential.

e. Results of Efforts to Establish University Offices

Every institution that has tried to increase the number of patents and licenses of university inventions has reported an increase in the number of inventions disclosed by faculty and an increase in the number of licenses of inventions successfully negotiated with industry by the university.

In conjunction with the establishment of a separate office within the university to address the university's patent and licensing needs, many universities have set out to increase the visibility of their patent and licensing program. Public relations efforts both inside and outside the university have accompanied a greater emphasis on technology transfer. Many institutions provide new publications directed to industry to advertise the resources of the university and its willingness to engage in negotiations. Some institutions hold seminars for industry representatives to introduce researchers, describe the university's capabilities, and tour the university's facilities and instrumentation. In some cases these activities are part of an effort by the state to attract new high technology industry.

2. Patent Management Firms

a. General

In 1977, Rensselaer Polytechnic Institute established its current procedures concerning patenting and licensing inventions. The Institute's major reason for changing its procedures was dissatisfaction among faculty with the patent-management firm previously engaged by the Institute. As a result, the Institute established a Patent Review Committee consisting of faculty members and administrators. Faculty researchers submit invention disclosures to the Committee. When the Committee determines that an invention has commercial potential, the Institute may patent it or submit it to a patent management firm. If the Institute retains the option to patent the invention, the Office of Grants and Contracts undertakes the task of preparing a patent application. Licensing arrangements are conducted by a patent attorney outside the Institute.

Such efforts demonstrate new uses of patent management firms. In the past, the typical arrangement between a university and a patent management firm had been as follows: the university would send all invention disclosures it received from faculty to the patent management firm for evaluation. The university would not compensate the firm for the evaluation of the invention. The firm would be under no obligation to accept the invention for further action, but if it did, the firm would receive a major portion of the royalties (as much as half) and the university and the inventor would share the remainder. Royalties would be paid after the firm was compensated for its efforts in patenting and licensing the invention.

b. Decline of Use of Patent Management Firms

The survey responses indicate that there is no longer a standard use of patent management firms among universities. Some institutions conduct patent management activities within the university while others have maintained long established relationships with a particular patent management firm.

The traditional arrangement with a patent management firm has become increasingly unacceptable to many universities because it requires the university to relinquish control of the decision to pursue a patent. Nor are faculty researchers satisfied with the passive role of many patent management firms and the lack of attention given to the development of their inventions. Several universities stated that one reason they abandoned their patent management firm was the dissatisfaction of researchers with their exclusion from the process of evaluating their invention for commercialization.

c. Alternatives to Patent Management Firms

Most of the institutions which have terminated a prior patent management arrangement have now established, as an alternative, an in-house patent and licensing office or a separate foundation associated with the university to perform the function of evaluating inventions for possible patent protection. The trend toward bringing the patent management function into the university or transferring the function to a foundation is clearly a response to the lack of attention by and control over patent management firms.

Some institutions have negotiated new arrangements with patent management firms to provide for more focused consideration of the university's invention disclosures. This approach is most often used in lieu of establishing an in-house capability for patent management, but several institutions have done both.

1. Example: University of Colorado

For example, the University of Colorado has an agreement with University Patents, Inc. (UPI), which was recently renegotiated to provide for special contingencies. The agreement provides that upon request of the Regents of the University, UPI shall grant a license to a university-owned invention "to a new venture funded in whole or in part either by the Regents, by the Colorado University Foundation, or by any affiliate of either of them..."/7 This provision allows the university to form or support a new company to develop an invention without the direct participation of UPI.

Further, if the Regents obtain a research grant or contract from a for-profit, nongovernmental entity, and such entity receives an option for other rights from the Regents with respect to future inventions made as a result of such funding, the Regents can exclude UPI from a share of such future inventions. This permits the university to include provisions concerning the development of inventions within a contract directly with an industrial sponsor.

The University of Colorado has established a foundation and a for-profit corporation, (to be discussed further in Part IV), in part because its former arrangement with UPI permitted UPI to accept only a small fraction of the invention disclosures offered by the university for commercialization. The corporation is expected to undertake the risk of pursuing inventions refused by UPI.

ii. Other Examples

Another example of a modified patent management agreement is demonstrated by the University of Kansas and Research Corporation. Under a new arrangement, a representative of Research Corp. travels to the university campus to seek out inventions among researchers. In addition, the University established an ad hoc committee to review inventions, rather than relying solely on the determination of the Research Corp. representative concerning the commercial potential of research results.

Purdue University has a similar arrangement with Research Corp.

in which a representative from the firm contacts each faculty member who has a research grant to determine whether any research results should be disclosed for possible commercialization.

3. Revisions to Royalty Arrangements

Another practice used to promote technology transfer within the university is the revision of the university royalty distribution arrangement with faculty inventors. For example, the University of Michigan changed its royalty distribution as an incentive to inventors following the recommendations of two faculty committees. The old distribution formula provided for a flat 20 percent share of the royalty income to the inventor. The remaining 80 percent was divided evenly between the inventor's department or school and the university to support further research. The newly revised formula provides for distribution of royalties, after the university recovers its expenses for patenting and licensing the invention, in accordance with a sliding scale providing for 50 percent of the first $100,000 of royalty income to be distributed to the inventor and the remainder divided evenly between the inventor's department and the university, 40 percent of the second $100,000 to the inventor and the remainder divided evenly between the inventor's department and the university, and 20 percent of any amounts over $200,000 to the inventor and the remainder divided evenly between the inventor's department and the university. The university's share is used to maintain and expand the Intellectual Properties Office. The department or school may use its share to support research activities of its faculty, at the discretion of the unit head.

The University of Washington also has a revised royalty distribution plan. After recovering an amount equal to 15 percent of the royalties for administrative expenses of the Washington Research Foundation, royalty income is distributed as follows: the inventor receives 100 percent of the first $10,000. Any amount received above $10,000, but not exceeding $40,000, is divided among the inventor (50 percent), the inventor's department (25 percent), and the Graduate School Research Fund (25 percent). Any amount over $40,000 is divided among the inventor (30 percent), the inventor's department (20 percent), and the Graduate School Research Fund (50 percent).

Modified royalty distribution arrangements were reported widely by respondents as an incentive to researchers to disclose inventions and to remain in the university rather than to enter the private sector in order to commercialize research results.

C. Summary

The survey responses regarding the efforts of universities to enhance technology transfer of university inventions conducted within the university's organizational structure tend to show that:

- most institutions have increased the number of personnel responsible for evaluating intellectual property, including the establishment of separate offices to promote technology transfer and to undertake patent and licensing activities;

- many institutions have reduced or abandoned the use of patent management firms because of the lack of their direct accountability to the university;

- most institutions have revised their patent policies to direct university resources to develop inventions and redistribute royalties to create incentives for faculty.

Part IV - Technology Transfer Conducted From Outside the University

A. Background

The survey questionnnaire asked respondents to describe any new entity created by the institution outside the university's organizational structure to undertake development and technology transfer of inventions. The survey asked respondents to describe how the decision was made to establish such an entity and the nature of the relationship between the entity and the institution.

Universities have undertaken technology transfer for many reasons, including:

- to promote economic development in the state;
- to attract and retain faculty;
- to generate income for the university;
- to fulfill a social duty to translate ideas to useful products and services.

Why a university establishes a technology transfer entity outside its organisational structure is a complicated question. Some institutions hope that the functions to be performed will be more efficiently carried out if their own decision-making structure is not utilized. Others believe that the types of decisions to be made, (i.e. the evaluation of the commercial potential of an invention and the successful development and marketing of a product) should not be under consideration by the very administrators that are operating an institution to perform basic research and to educate students. Income from commercial activities may jeopardize the tax-exempt status of the institution.

The anticipated advantages of conducting an institution's patent, licensing, and other technology transfer activities outside of the university include:

- providing greater identity and visibility of those activities to the business and venture capital community;
- avoiding entanglement with university requirements or administration or, in the case of public institutions, statewide or systemwide restraints;
- allowing for flexibility within the new organization to respond to opportunities without taking the entire university's interests into consideration.

B. Results of Survey

Based on the responses to the survey, entities to conduct technology transfer outside the university may be placed in two categories: nonprofit foundations and for-profit corporations.

Few universities reported on technology transfer activities outside their university. The institutions that did report that they had established foundations or corporations outside the university provided descriptions or materials that promoted their activities and future plans. The actual accomplishments of these activities, however, generally remain untested.

One recently established foundation has been denied tax-exempt status by the Internal Revenue Service. The Service's decision was upheld by the United States Tax Court, which agreed that the commercial activities of the foundation interfered with its charitable, scientific, or educational purpose.

In the case of the for-profit technology transfer companies established by universities, the Clearinghouse was unable to acquire information on the financial status of the companies. Although this lack of information alone does not lead to a generalization, several university administrators contacted by AAU expressed disappointment and uncertainty regarding the ability of these companies to attract investors.

1. Nonprofit Foundations

a. General

Of the 39 respondents, ten reported that their universities had established nonprofit technology transfer foundations. Nonprofit technology transfer foundations of universities have been established for the primary purpose of owning the university's patented inventions and supporting further research on campus with the royalty income received from commercialization of those inventions.

b. Example: Wisconsin Alumni Research Foundation

The classic example of a nonprofit technology transfer foundation is the Wisconsin Alumni Research Foundation (WARF) at the University of Wisconsin. WARF was founded in 1925 when the University Board of Regents refused to permit the university to apply for a patent on a university scientist's discovery that vitamin D could be produced in foods and drugs through ultraviolet irradiation. WARF accepted the scientist's assignment of the discovery and proceeded to patent and license it, directing much of the income from the discovery to the university.

WARF continues to patent faculty inventions and to support further university research with the proceeds. WARF's articles of incorporation (second restatement, May 2, 1975) state its purposes, including:

> To promote, encourage, and aid scientific investigation and research at the University of Wisconsin by the faculty, staff. alumni, and students thereof, and to provide or assist in providing means and machinery by which their scientific discoveries, inventions, and processes may be developed, applied, and patented, and by which such utilization or disposition may be made of such discoveries, inventions, and processes and patent rights or interests therein as may tend to provide funds for and to stimulate and promote further investigation and research within said University.
>
> To pay out and distribute the corporation's funds to or for scientific investigation and research at the University of Wisconsin. /8

WARF is totally independent of the university. It has no faculty members, regents, or administrators on its Board of Directors. WARF acts as the patent and licensing manager of an invention assigned to it.

Until 1983, WARF provided fifteen percent of the net royalties on an invention to the inventor. At that time, WARF's royalty payment policy was changed. Presently, an inventor receives a $1000 payment from WARF when a patent application is filed on his or her invention. If the invention is successfully licensed, the inventor is entitled to twenty percent of the gross royalty payments received by WARF on the invention. WARF will accept an equity interest in an inventor's company when the company is the licensee of the invention.

In addition, fifteen percent of the gross income is provided to the inventor's department to support research. The departmental executive committee decides how this research support will be used, and may decide to invest the funds to produce income for the department to use for research. The remaining income from the invention is provided to WARF to carry out its support of research at the university.

WARF's support of research activities at the university is extensive. WARF provides all of its net income each year to the university to support research activities ($8.5 million in FY 1986). The overwhelming majority of WARF's current income is derived from an endowment which has been the beneficiary of royalty income from a small number of highly successful patents, including the irradiation process dating back to WARF's inception. WARF attributes its continued success in part to the outstanding financial management of its portfolio.

WARF does not participate in the selection of research to be funded. The Graduate School Research Committee, which consists of over 30 rotating faculty members appointed by the Chancellor of the Madison campus, submits a budget request to WARF each year based upon research proposals approved by the Committee for funding. Proposals are submitted directly to the Committee by faculty members.

Recently, WARF expanded its role beyond patent management. It organized a wholly-owned fully taxable subsidiary in 1984 to design, manufacture, and market an improved hearing aid device based on digital microchip technology. The new company is a joint venture with an established Wisconsin corporation and is intended to reduce the lead-time between research and delivery of the product to the marketplace.

c. Example: Brown University Research Foundation

The Brown University Research Foundation was chartered to develop technology transfer with industry. The Foundation is a separate legal corporation from the University, but its Board of Directors consists entirely of university administrators. The University pays the Foundation for its services and all royalties are provided to the University for distribution in accordance with its patent policy. Beyond the typical patent and licensing arrangements, the Foundation has formed new ventures, including an arrangement in which the university and a corporation became equal partners in a joint venture. The Foundation has also taken an equity interest in a company in exchange for the technology it owned.

d. Example: University of Pittsburgh Trust and Pittsburgh Foundation for Applied Science and Technology

The University of Pittsburgh established the Pittsburgh Foundation for Applied Science and Technology in 1982. Although it was originally a wholly-owned subsidiary of the University, it is currently a wholly-owned subsidiary of the University of Pittsburgh Trust. The Trust was established in 1983 as a wholly-owned subsidiary of the university to operate ventures outside the traditional university activities. It was hoped that the establishment of the Trust would permit the university to support profit-making ventures without jeopardizing its tax-exempt status, remove the university from direct legal liability for products or services of such ventures, and provide funding to the university for reinvestment. The University's Board of Trustees approved the formation of the Trust. The Foundation was established after consultation with faculty and the Board of Trustees.

The Foundation's purpose is to bring together the university, private sector research and development resources, inventors, entrepreneurs, and venture capital to develop new technology, to conduct technology feasibility, marketing, and financial analyses of new inventions, to assist in acquiring funding for inventors and small firms, to develop business plans associated with inventions, and to take an equity interest in new ventures. The Foundation has an equity interest in six companies.

The University of Pittsburgh is an example of an institution that has the benefit of both its own new entity and the support of an active state economic development program. The Foundation has established a Center for Entrepreneurial Assistance funded by the Ben Franklin Partnership (an economic development program in the State of Pennsylvania), to provide funds for start-up companies. The University of Pittsburgh is an active participant with Carnegie-Mellon University in the Western Pennsylvania Advanced Technology Center, one of the centers established as part of the Ben Franklin Partnership to foster high technology industry in the state. The Center funds research projects and one-third of its funding is provided by the state ($4.7 million in 1984).

e. Example: Washington Research Foundation

In the case of the Washington Research Foundation (WRF), initial funding for the Foundation was provided through a bank loan underwritten by business enterprises in the state. One of the purposes of the WRF is to increase high technology enterpreneurship in Washington State. WRF is intended to serve several universities and nonprofit research centers and to be active with and visible to the business community. Faculty members at the University of Washington submit their invention disclosures to the university's Office of Technology Transfer but it is the WRF that actually evaluates the invention and advises the inventor and the university on a patent and commercialization strategy. The university assign its right to the invention to the WRF which applies for the patent, selects a licensee, and may help the licensee arrange financing and marketing of the invention. Royalty payments are made to the WRF which reimburses itself for its expenses on the invention and pays the remainder to the inventor, the inventor's department, and the Graduate School Research Fund. WRF has also expanded its activities beyond patent and licensing arrangements to establish the Biological Materials Distribution Center to make available, for a fee, biological materials from the University of Washington to commercial companies for research purposes only.

f. Federal Tax Implications of Foundations: Tax-Exempt Status

In 1985, the United States Tax Court determined that WRF was not operated exclusively for charitable, scientific, or educational purposes within the meaning of section 501(c)(3) of the Code and therefore was not tax-exempt. Based on the facts adopted from the administrative record, the Court determined that WRF's proposed activities (it was not operational at the time of the administrative proceedings) further a substantial commercial purpose, that is, the successful licensing of technology to maximize royalties. The substantial commercial purpose of the Foundation rendered it taxable.

The WRF Tax Court case may affect the current and future tax-exempt status of other technology transfer foundations, making it more difficult for other foundations for which the primary purpose is patent management and technology transfer to operate as tax-exempt organizations. However, several aspects of the formation and purposes of WRF differ from WARF and were considered by the Tax Court in its determination of WRF's commercial purpose:

- WRF was capitalized by a bank loan guaranteed by business entities.
- WRF's purposes include strengthening and diversifying the economy of Washington State, as well as increasing the rate of technology transfer from universities.
- WRF proposed to obtain patents and other rights to inventions and license them, provide information regarding technology transfer, and publish a newsletter on its patents. Its activities did not include a research support component, although WRF asserted unsuccessfully that its royalty payments on such patents could be used to support research at universities.

2. For-Profit Corporations

a. General

The second category of technology transfer entities established to conduct such activities outside the university is for-profit corporations. Of the 39 respondents, five universities reported that they had established technology transfer companies.

b. Example: Michigan Research Corporation

The University of Michigan established the Michigan Research Corporation (MRC) in 1985 to develop inventions of University faculty and to promote technology transfer and entrepreneurship at the University. The original idea for a technology transfer entity was suggested by a fifteen-member Task Force on University-Industry Interaction, composed of faculty members and administrators appointed by the University's Vice-President for Research in 1981. The Task Force recommended that a nonprofit entity be established to act as a broker between faculty and industry to commercialize their research ideas. The Task Force report suggested that MRC be controlled by a Board of Directors to include business representatives but with majority University representation on the Board. MRC would also be guided by a Scientific and Technical Advisory Board to identify activities with commercial potential and to review proposals for new programs. MRC would contract with the University for office space and administrative and business services. In all other respects, MRC was conceived by the Task Force to have the same access to University facilities as any other University unit.

The Task Force anticipated that MRC would aggressively pursue the commercial exploitation of research results. MRC would create interdisciplinary project centers to develop research results and compensate its staff competitively with the private sector. Actual development of a marketable product would be conducted by licensees or by the faculty inventor through his or her own company, which could receive financial. management, and business liaison assistance from MRC. "In either case, MRC, the faculty entrepreneur. and the University could have equity positions in the product being marketed." /9 The Task Force expected MRC's capital to come from several sources, including the University, industry, private foundations, and the federal government.

Further consideration of the concept was undertaken by a faculty member and an administrator, with the assistance of a faculty steering committee. They produced options to be considered by the Faculty Senate on June 21, 1982 which dispensed with the nonprofit model and recommended a for-profit MRC. Their written recommendation is attached as Appendix C.

Following the adoption of the recommendation to establish a for-profit company, the University Regents approved a loan to MRC.

The University and MRC entered into a contractual arrangement on March 20, 1985 entitled "The University of Michigan Commercial Development Sponsorship with the Michigan Research Corporation". That document identified the area in which the University expected MRC to be most active: "the commercial sponsoring of an undeveloped idea which has the potential for commercial success, but needs significant further sponsored research and development, and business sponsorship to develop its potential." /10 MRC is expected to be advised by the University's Intellectual Property Office of new ideas resulting from research at the University. MRC will then be given an opportunity to complete a patent search and develop a business plan, during which time the University will refrain from pursuing any arrangements with other third parties for commercialization. If accepted by the University, MRC's plan will be implemented during a "time-limited exclusive option to arrange for commercialization". /11

Further amendments to the document were agreed to on April 23, 1986. /12 It provides procedures for MRC's development of start-up companies with faculty and allocation of an equity interest in such companies to the university.

MRC is still in the early stages of its activities. It has been seeking Small Business Innovation Research (SBIR) funds from the federal government to provide funding support for its operations. No information is available regarding MRC's ability to attract funding or its technology transfer activities.

c. Example: University Research Corporation (Colorado)

The University of Colorado established a for-profit corporation named University Research Corporation (URC) in 1983. The corporation's Articles of Incorporation state that its purpose is: "to develop and market research discoveries, to invest in and operate business entities established to develop and market research discoveries, all generally in cooperation with research institutions located within the State of Colorado." /13

URC is authorized to issue common stock and to offer its stockholders the right to invest in spin-off ventures resulting from its technology transfer activities, to provide funding in exchange for equity interests in spin-off companies, and to enter into joint ventures to support an inventor's commercialization of new technology. URC's Board of Directors is intended to be independent of the University, although it is to include one representative of the University of Colorado Foundation. URC is also in the early stages and no information is yet available regarding its financing or technology transfer activities.

d. Joint Ventures

Two universities reported that they have joined with venture capital firms to establish for-profit corporations. Washington University is in the formative stages of establishing an organization using university technology to start new local companies. The university will provide the technology, the venture capital company will manage the company, screen the technology for commercial viability, organize and staff the new companies, provide or attract needed capital, seek licensees, arrange for product development, and sell or convert start-up companies to publicly-held corporations.

The Michigan State University Foundation supported the creation of the Neogen Corp. in 1981. Neogen also received funding from venture capital companies. Its purpose is to develop products and services from Michigan State University research, to arrange for faculty to undertake ownership in technology they develop, and to enhance biotechnology development in the State of Michigan. Neogen supports research at Michigan State and receives a license to any patentable inventions resulting therefrom. Neogen can develop a new product from an invention or support a new start-up company. The faculty may submit research proposals to the University to be presented to Neogen for funding. However, the company conducts its own evaluation of the research proposals it selects for support.

e. Wholly-Owned Subsidiaries

Two universities have established wholly-owned subsidiaries of the university to conduct technology transfer activities. Washington University established the Washington University Technology Associates (WUTA) to undertake product development activities from technology developed at the Engineering School. WUTA was established to perform or contract out product development, to start-up small companies, and to assist small companies with licensed technology.

Case Western Reserve University established a wholly-owned subsidiary which was named University Technology Incorporated (UTI). UTI has responsibility for commercial technology transfer campus-wide. It has an independent Board of Directors selected by the University. UTI was created to evaluate the commercial potential of university technology, to design and implement development strategies, and to market technology. UTI may license an invention, enter into joint ventures, and assist in creating start-up companies. The University's Office of Research Administration reviews invention disclosures and then refers them to UTI. If the technology requires further research, the Office of Research Administration is prepared to assist the researcher in obtaining further research support. If the invention requires further development, UTI will arrange development support. The company also provides an intellectual property protection strategy, assesses the market for the product, designs a business strategy for marketing the product, and arranges for financial underwriting of the product.

C. Summary

Whether universities will successfully establish technology transfer entities outside the university structure remains unanswered. The nonprofit model has been challenged by the Internal Revenue Service because of its commercial activities. However, the for-profit entities do not yet have any discernible track record for attracting investors. It remains to be seen whether universities will be able to structure technology transfer and commercial development activities in a manner that maintains the university's academic and research missions and undertakes successful commercial activities.

PART V - CONCLUSIONS

Can universities support research activities in an impartial scholarly manner and then participate in the commercialization of research results as competitors in a business environment? It is clear that universities are exploring this question and will experiment with different structures to combine these two goals. The success of such activities depends upon the expectations of the institutions. The universities that have chosen to reorganize their internal patent and licensing capabilities have already achieved increased disclosures and income from licenses. The universities that are currently trying to organize technology transfer entities outside the university structure may have difficulty finding a nonprofit structure that can be sufficiently entrepreneurial or a corporate structure that can compete with private business. Federal and State incentives have increased the odds for success, but whether universities will find it worth the effort and expense of being their own entrepreneurs is yet to be determined.

NOTES

1/ See Report by the Comptroller General of the United States entitled _Federal Agencies' Policies and Practices Are In Accordance with Patent and Trademark Amendments of 1980_.

2/ Ibid.

3/ Committee Report of the House Science and Technology Committee accompanying H.R. 5003, The Uniform Science and Technology Research and Development Utilization Act, ordered to be printed August 15, 1984, p.14.

4/ _Technology and Growth: State Initiatives in Technological Innovation_, final report of the Task Force on Technological Innovation of the National Governors' Association, October 1983, p. 8-9.

5/ Letter dated September 4, 1985 to AAU from Katherine C. Lyall, Acting President of the University of Wisconsin, p. 1.

6/ See May 1, 1985 letter from James R. Brophy, Vice President for Research at University of Utah quoting remarks of President Peterson at meeting of the University's Institutional Council.

7/ Servicing Agreement between the Regents of the University of Colorado and University Patents, Inc. dated May 19, 1981, revised October 10, 1984, p. 4.

8/ Second Restated Articles of Incorporation of the Wisconsin Alumni Research Foundation, as of May 2, 1975, Article 3. Paragraphs (1) and (2) of Item B.

9/ "Interim Report of the Task Force on University/Industry Interaction." University of Michigan, June 2, 1981, p. 5.

10/ "The University of Michigan Commercial Development Sponsorship with the Michigan Research Corporation." March 20, 1985, p. 1.

11/ _Ibid_, p. 3.

12/ Letter to Reed B. Harker, President, Michigan Research Corporation from Linda S. Wilson, April 22, 1986.

13/ Articles of Incorporation of the University Research Corporation, April 15, 1985, p. 1.

APPENDIX A

Association of American Universities

Office of Federal Relations

April 26, 1985

TO: AAU PRESIDENTS AND CHANCELLORS

FR: ROBERT M. ROSENZWEIG

RE: CLEARINGHOUSE ON UNIVERSITY-INDUSTRY RELATIONS

I am writing to ask your cooperation on the second project of the AAU Clearinghouse on University-Industry Relations. As you will recall, the Clearinghouse was established in response to congressional concern that universities must be aware of the potential "ethical dilemmas" posed by research activities with industry. The Clearinghouse has been in operation since 1983, collecting and disseminating information. The first report of the Clearinghouse was issued in February of this year and it concerns conflict of interest and delay of publication. The information we received as a result of the first request is informative both in demonstrating how each institution resolves its own policy problems and in establishing how research universities are addressing these issues generally.

We are now requesting information on activities intended to extend the university's role in the research enterprise beyond the conduct of basic research to include participation in the transfer of technology to the marketplace. The range of possible activities reaches from an active patent and licensing program to the establishment of a corporation to develop products resulting from university research. We would like to receive descriptions and accompanying documentation, including any public relations materials. Equally valuable are examples of such activities which the university decided not to undertake, or which the university abandoned.

I recognize that we are not asking easy questions, but the thoroughness of each response is crucial to the success of our effort. As before, we are not requesting confidential information. If it is necessary to delete names, dates, dollar amounts, or other specific details from documents, we would be pleased to receive them in such form. The actual language of contracts and policies is especially useful.

The following examples may make clearer the kind of information we seek and the value that such information might have to university officers.

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> In response to changes in the law which permit universities to own the patent rights to inventions developed with federal funds, University X has decided to develop its in-house patent and licensing capacity. In addition, the university is undertaking a new marketing strategy to inform possible licensees of the inventions available for licensing by the university and is encouraging faculty members to be aware of the commercial applications of any inventions developed in their laboratories.

1. Has your institution adopted new procedures to enhance the income flow to the university from the development of research results?

2. If so, describe the procedures adopted, i.e. have you created a new office or hired new staff, have you developed a public relations campaign?

3. If not, do you use a patent management firm to evaluate inventions and seek licensing arrangements?

4. Are you conducting an active search among faculty for technology innovations and inventions that could be licensed?

5. Have the changes in federal patent policy within the last five years influenced how your university treats non-federal support of research? Have these changes influenced how your university treats technology transfer and marketing of research results?

Some institutions have taken steps beyond the above example to create a new entity outside the institution's research structure to undertake development and technology transfer of inventions.

> Several institutions are involved in the activities of a non-profit research center, funded by corporate investment, which enters into funding agreements with the universities and receives licenses to any patents. The research center then transfers the licenses to a separate corporation established by the same corporate supporters to develop the patented technology. The research center owns one third of the corporation stock.
>
> Another institution has established a for-profit corporation to develop products and support new start-up companies from technologies available at the university. Outside investors may make investments in the corporation. All decisions regarding the identification, screening, and evaluation of technologies is conducted by a committee of university faculty members.

1. Has your institution embarked on similar ventures? Please describe them.

2. If so, how did the university make the decision to undertake them; i.e. was the institution approached by outside interests, was the decision presented to the faculty, did the institution receive legal (including tax), advice?

3. Are there policies or limits, either written or understood, that govern the relationship between the new ventures and the university? For example, does the university or its faculty participate in the selection of research to be supported by the new entity?

4. Has the university accepted any new financing arrangements for research or development as a result of this new enterprise?

We are interested in receiving any other information about similar arrangements at your institution or actions your university has taken to enhance the transfer of technology developed on your campus.

The final aspect of the university's role in technology transfer in which we are seeking information relates to the university's intellectual property policies. We are interested in receiving written policies regarding patents, copyrights, trade secrets, software, licensing, and royalty distribution. Examples of negotiations with industrial sponsors and licensees would be very useful.

1. If your institution has established a mechanism to enhance technology transfer, how has the university addressed the treatment of technology that is not patentable?

2. If your university has established a separate entity to undertake technology transfer, does that entity have separate policies regarding the treatment of intellectual property?

3. When the university itself is evaluating the commercial applications of an invention, it may determine that the technology is not patentable but could be valuable as a trade secret. How has your university addressed the protection of trade secrets?

I know we are asking your institution to undertake a significant task in responding to this request. I am convinced that it will be in the university community's best interest to share information. It is important to demonstrate to those who are concerned about the ethical and legal problems often associated with research business ventures that universities are addressing them. We hope your institution can assist in this effort.

All responses should be received at AAU by June 15, 1985. Please direct any inquiries and responses to:

April Burke
Director
Clearinghouse on University-Industry Relations
Association of American Universities
One Dupont Circle, N.W., Suite 730
Washington, D.C. 20036
202-466-5030

Please let us know the name, address, and phone number of any member of the university's staff who will be assisting with the response to this request.

Thank you.

APPENDIX B

LIST OF RESPONDENTS

Brown University

Carnegie-Mellon University

California Institute of Technology

Case Western Reserve University

Columbia University

Cornell University

Duke University

Harvard University

Iowa State University

Johns Hopkins University

Michigan State University

New York University

Northwestern University

Ohio State University

Pennsylvania State University

Princeton University

Purdue University

Rensselaer Polytechnic Institute

Rockefeller University

Stanford University

Tulane University

University of California, Berkeley

University of California, Los Angeles

University of California, San Diego

University of Colorado

University of Illinois

University of Iowa

University of Kansas

University of Maryland

University of Michigan

University of Missouri

University of North Carolina

University of Pennsylvania

University of Pittsburgh

University of Texas

University of Utah

University of Virginia

University of Washington

University of Wisconsin

Vanderbilt University

Washington University

Yale University

APPENDIX C

Senate Assembly Meeting
of June 21, 1982

Recommendation Options for The University of Michigan Toward the Establishment of a "Michigan Research Corporation"

by

Dr. Walton Hancock and Larry Crockett
Institute of Science and Technology

In response to strong faculty expressions of interest in transferring their scientific technology to the industrial/business sector, the Vice-President for Research appointed a 15-member joint faculty/administrators' task force. Chaired by Dr. Robert Howe, this group developed in June 1981, the "Interim Report of the Task Force on University/Industry Interaction" which recommended the creation of a non-profit Michigan Research Corporation (MRC) to act as a "broker" to industry for interested faculty, to support technology transfer for commercialization of their research ideas. It was believed that such an organization would foster intellectual scientific interaction between the University and local industry, to the benefit of both, and would help to retain in Ann Arbor our more entrepreneurial faculty, graduates, and spin-off high technology companies. Other universities had experienced or were anticipating losses of major faculty members to private industry, and a number of universities had or were establishing centers, foundations, or corporations to assist their faculty and hopefully to generate income for the universities.

After campus-wide discussion of the Howe Report with deans and faculty committees, the Executive Officers accepted the recommendation that more specifics on an MRC needed to be developed and comparisons be made to similar organizations already existent or being created at other universities. A growing number of such institutions were also making multi-million dollar research and development arrangements with private corporations, designed to help faculty research and training efforts, while providing ideas through licensing to industry.

Thus, under the auspices of the Institute for Science and Technology, we (Dr. Walton Hancock, Professor of Industrial and Operations Engineering and of Hospital Administration, and Larry Crockett, Research Program Manager of the Special Projects Division of IST) were assigned to do a thorough study and develop further the concept of an MRC. We reviewed our ideas with a faculty Steering Committee consisting of Drs. David Brophy, James Duderstadt, Thomas Dunn, George Gamota, Robert Howe, Raymond Kahn, and Joseph Martin. We then:

(1) expanded the Howe Report's list of universities that have formal technology transfer operations, and either talked to the parties involved or visited them;

(2) talked to people in the University concerning the desirability of the establishment of an MRC;

(3) developed a bibliography with 114 citations on these subjects; and

(4) wrote a report which contains a discussion of what were perceived to be the more critical issues, with appendices documenting the efforts of 28 other universities in technology transfer.

That Report, published January 7, 1982, by Hancock and Crockett, "Discussion of the Michigan Research Corporation Proposal"*, has been discussed with a number of University committees, including deans, directors, research administrators, executive committees, and faculty groups. While favoring the creation of some sort of MRC organization, the report purposefully did not make recommendations about where the MRC should be located (inside or outside the University), how it should be controlled or constituted (non-profit or for-profit), how it should be financed (University and/or private funding), etc.

However, in response to such questions from faculty and administrators at all the presentations made to date, we have outlined three recommendation options for The University of Michigan toward establishing an MRC-like organization:

#1. Set up a for-profit corporation outside the University--
We strongly favor this recommendation.

#2. Set up a non-profit MRC-like group within the University--
We feel this is possible but considerably weaker than #1.

#3: Do nothing about an MRC--
We feel this will not help our faculty and will continue our weak image and low profits in technology transfer.

RECOMMENDATION #1: Set Up a For-Profit Corporation Outside the University

The University would become a minority stockholder in a new Corporation. The University would provide a one-time equity of approximately $200,000. These start-up monies would be used to:

a) Identify one or two University faculty ideas with excellent commercial potential.
b) Organize the Corporation.

---

*A copy of the full report is available from IST Special Projects Division.

c) Appoint a president.
d) Attempt to obtain research and operating funds to reduce the ideas to a marketable product. This will include equity capital from venture capital companies, individual investors or private industries.
e) Obtain support from the State of Michigan and/or foundations if possible.

The first priorities of the Corporation would be to:

a) Perform market evaluations and attempt to identify two or three potential commercial ideas by extensive contacts with faculty and staff.
b) Raise operating funds through grants and equity capital. Estimated needs are $500,000 - $1,000,000 per project to be commercialized. Limited research partnerships would be used as desired to attract private investments; this year's Federal Income Tax credits make such investments very attractive. Grants from government agencies, foundations, and business organizations would be sought. Equity capital might later be raised from the sale of stock on the open market.
c) Contract with the University faculty to do as much as possible of the research and development work. This will provide substantial funds to the University for its faculty and staff to perform their desired research.

At the same time, we strongly recommend that the University itself continue to operate the patent/licensing functions it does in the Division of Research Development and Administration, but with:

a) an expanded staff that could more actively encourage patentable ideas
b) a revision of the patent policy to provide more monetary incentive to the author/inventor in royalty return
c) a computer software licensing policy different from the patent policy, with sufficient flexibility to provide for ongoing support of software systems.

The Advantages of Recommendation #1 (Separate Corporation) are:

a) Ability to obtain equity capital outside the University.
b) Responsible involvement/investment by individuals or businesses.
c) Research to be funded whenever possible at the University.
d) Maximum flexibility to respond quickly to changing conditions (to form new corporations, start limited research partnerships, pay staff competitive wages, etc.).
e) Business-oriented, technically-expert staff will provide strong decision-making.
f) Small investment by University
g) Limited University liability on commercial products.
h) Higher probability of getting State Development funds that would not detract from general support to the University.
i) Enhanced total University environment

j) Improved economic environment of the State and Ann Arbor. (Within our State last year, the Michigan State University Foundation legally incorporated in this way the new Neogen Corporation).

The disadvantages of Recommendation #1 are:

a) The University would not completely "control" the Corporation, but would have a say as a stockholder.
b) The risk of failure of the effort is higher because of the limited support from the University.
c) Some faculty may find the new industrial environment more favorable than that of the University, although other faculty may stay at the University because of these new local entrepreneurial options.
d) Surplus funds accruing to the University may depend upon its equity commitement, although the University's main equity will likely be the faculty ideas and research products, for which a share of the commercial profits will be claimed.

RECOMMENDATION #2: Set up an MRC-Like Group Within University, (Probably in IST)

The University would:

a) Establish an internal technology transfer organization within the University, probably in the Institue of Science and Technology.
b) Fund the group for at least two years at an estimated cost of $120,000 per year.
c) Solicit from the faculty and staff potential commercial ideas, and get a technical and business market analysis to help select promising ones for development.
d) Revise staff salary policies so that our competitive position could be maintained relative to industry.
e) Give the organization sufficient power to:
    (1) Execute licensing and royalty arrangements.
    (2) Execute contracts.
    (3) Establish compensation levels.
    (4) Establish limited research partnerships with external sources.
f) Revise the University patent and software policies and expand the patent staff (not part of the above $120,000) as indicated in #1 above.

The first priorities of the organization would be to:

a) Establish a nonprofit corporation called the Michigan Research Corporation (MRC).
b) Solicit potential commercial ideas from the faculty and staff for development.
c) Raise funds through grants, selected licensing arrangements, and limited partnerships.

d) Transfer funds to get research accomplished as much as possible by the faculty and staff within the University organizations.
e) Arrange for the work to be accomplished elsewhere if it is not appropriate for the University.

The Advantages to Recommendation #2 (MRC within University) are:

a) The University would have complete control.
b) The activity is part of the present charter of IST.
c) The total University environment would be enhanced.
d) All surplus funds generated would accrue to the University.
e) An improved economic environment of the State might result.

The Disadvantages of Recommendation #2 are:

a) If the MRC group is not successful, the University would have a continuing liability for personnel, etc.
b) The University may have direct product liability on those items commercialized.
c) There is a lack of speed, flexibility, and tough business decision-making authority in University units.
d) There is no precedent for this high level of delegated authority within the University.
e) The business community will have difficulty becoming involved at a responsible/investment level. (In this State, Michigan Technological University has recently established Michigan Tech Ventures, Inc., a wholly-owned internally-funded, for-profit corporation to overcome this difficulty.)
f) It will not be able to obtain equity capital from the outside.

RECOMMENDATION #3: Do Nothing About an MRC-Like Organization

The University would:
a) Be encouraged to modify the patent and software policies and support as indicated in #1 above, but
b) Continue to support patents and licensing at a relatively low level.

Mr. **Walgren**. Let me add one other request to the idea of submitting some effort to measure these things. We talk now about the potential of this patent availability for small business and universities. Yet there has been some clear patent availability for small businesses and universities since, I believe it was, 1980 in the law. My concern is that now we are holding out this life raft that may already have been out there for a number of years, and either something or not very much happened.

I would like to ask you if you couldn't try to measure what has happened in response to the 1980 effort to allow small businesses and universities to participate in patent incentives that, as I understand it, have been a matter of law since that time.

Mr. **Riggs**. We will do that.

Mr. **Walgren**. We would appreciate your pointing us to that and adding your own assessments to it as well.

Let me recognize the gentleman from California, Mr. Brown.

Mr. **Brown**. Mr. Chairman, I don't have any questions but I do want to compliment Mr. Riggs and the Executive Branch in total for the initiative represented by the President's Executive Order. I think it is a good step forward. We are not at all clear whether it may need additional effort, but certainly we want to take steps like this and to move them and carry them out aggressively. It appears that you are doing that and you are to be commended for it.

Mr. **Riggs**. Thank you.

Mr. **Walgren**. And the gentleman from North Carolina, Mr. Valentine.

Mr. **Valentine**. I thank you very much, Mr. Chairman. I don't have any questions.

Mr. **Walgren**. On behalf of the committee, we certainly appreciate your coming, and we look forward to interacting with you in hopes of encouraging some of these things to have real life. Thank you, Mr. Riggs.

Mr. **Riggs**. Thank you very much for the invitation, and we will respond to these issues that you have put to us. Thank you very much.

Mr. **Brown**. Mr. Chairman.

Mr. **Walgren**. The gentleman from California, Mr. Brown.

Mr. **Brown**. Mr. Chairman, I would ask unanimous consent to insert an opening statement at the beginning of the hearing, and after the remarks of the chairman and the ranking Minority member.

Mr. **Walgren**. Without objection. And we will also offer for the record a statement by the ranking minority member, Mr. Boehlert, for insertion under the same request.

The next panel, Dr. Allen Rosenstein, Professor of Engineering, University of California at Los Angeles; Mr. Stanley Winkelman, the President of Stanley Winkelman Associates of Detroit, MI; and Dr. Russell Drew, the President Elect of the Institute of Electrical and Electronic Engineers.

If you folks would come forward. We appreciate your coming to talk with us about this area of what we can do to better organize ourselves, and to take greater advantage of the resources that we do commit on the federal level.

As many may know, Dr. Rosenstein has been interested in this area for a number of years, and has worked closely with members of this committee. Mr. Brown, in particular, has been particularly interested in developing the perspectives that Dr. Rosenstein has developed over the years, and we really do appreciate the citizen effort that has come from people like yourselves. Clearly, if we can't take guidance from people who are as committed and in such good contact with these problems, we are not doing the best by the country, and we really do appreciate the commitment that you have shown and your interest in these areas.

We will make written statements a part of the record completely, and you can feel free to focus on points that you might want to make in any other way that you'd like to highlight them.

So let's start with Dr. Rosenstein.

STATEMENTS OF DR. ALLEN B. ROSENSTEIN, PROFESSOR OF ENGINEERING, UNIVERSITY OF CALIFORNIA AT LOS ANGELES, LOS ANGELES, CA; STANLEY WINKELMAN, PRESIDENT, STANLEY WINKELMAN ASSOCIATES, CONSULTANTS, DETROIT, MI; AND DR. RUSSELL DREW, PRESIDENT-ELECT, INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS, WASHINGTON, DC

Dr. ROSENSTEIN. Thank you, Mr. Chairman.

Mr. Chairman and members of the committee, I am Allen Rosenstein, chairman of the board of Pioneer Magnetics, and professor of engineering at UCLA.

I am pleased and privileged to testify in support of H.R. 2165, the National Policy and Technology Foundation Act of 1987.

The legislation which you are proposing provides badly needed machinery to address and resolve some of the most critical problems facing our nation. We are here today because the nation is in trouble. America is losing the trade war; our standard of living is suffering.

Lowering the exchange rate has not worked its magic. The trade deficit is still with us. In spite of what some of our eminent economists will say, it will not go away. U.S. competitiveness has been declining for four decades, with exchange rates which were much more favorable in general than those of today.

Now it is human to blame one's own failures upon the actions of others. When the loss of trade competitiveness could no longer be ignored or denied, we have found comfort in believing that the successful trading nations were not playing by our rules. It is true that market restrictions and practices by our trading partners have contributed to our problem.

However, all other efforts fail in comparison to the damage we have done to ourselves. By most estimates, unfair practices are responsible for only 10 to 15 percent of our trade deficit. The remaining loss has been self-inflicted. The solutions to America's trade problem will not be found in Japan. They must start at home.

Our four-decade long competitiveness decline cannot be stemmed until we understand and address the underlying causes for our loss. Treating trade symptoms will not cure the competitiveness disease.

There are two very fundamental reasons for our present predicament that we must ultimately face if we are going to have a long-term resolution.

First, there is the obsolescence of the national policymaking process. Our inability to deal with the trade deficit and the budget deficit are but two examples of this failure.

I would like to point out that Gramm-Rudman-Hollings really stands as a monument to the collapse of the policy process.

Secondly, whereas all other developed nations treat their industrial base as a national resource, U.S. industry is disadvantaged with respect to its international competitors for every important determinant of trade competitiveness. Our means for developing and deploying technology are outmoded, uncompetitive, and in critical instances, nonexistent.

Furthermore, U.S. national policy supports practically everything except the very foundations of our society, the manufacturing plant that must supply the goods and services that maintain this nation's life quality.

From the industrial standpoint, U.S. national policy is unsupportive, counterproductive, and often just plain self-defeating.

The general disadvantagement of U.S. industry has been so persuasive—so pervasive and, I might say, persuasive, and all-inclusive, as to become an accepted part of the business environment. Lacking coherent national policy and struggling with inefficient means for developing and deploying civilian technology, U.S. industrial advantage has gone abroad and trade deficits have come home.

Consider the very fundamental question of technology development and deployment, and then compare our institutions with those of our most popular competitor. And we should recognize, to begin with, that the ultimate payoff comes with the deployment of technology, not with the development.

Japan, very early in the game, understood the dominant role of technology in the realization of national policy. Interestingly enough, essentially all important aspects of the U.S. agricultural system have been adapted and refined for Japanese industry, including 16 national industrial laboratories. Particular consideration has been given to the development and deployment of industrial technology for all industry. MITI offices and programs range from assistance to small and medium industry, to national projects requiring extensive industry, government, university, and national laboratory cooperation.

Few opportunities are ignored. Attention is given to the development of fundamental technology, as well as urgent and feasible technology.

The role of Government in Japan is to act as a convenor, a facilitator, and partner to industry. The success of the Japanese strategy hinges upon free and voluntary industry participation. The government seldom provides the bulk of the funding or the personnel.

Some understanding of the efficiency and timeliness of the Japanese strategy for developing and deploying critical technology can be obtained by briefly examining the history of some important Japanese technological initiatives.

Back in the days, if we can still remember them, when U.S. firms completely dominated the world semiconductor market, Japan invested in the cooperative fourth generation computer project to develop the manufacturing technology for the next generation of large scale integrated circuits.

That program ran for 4 years, 1976 to 1980. Five companies participated in the project, along with MITI's electro-technical laboratory. The initial budget was $300 million, with MITI contributing only 40 percent.

I think the Japanese domination of the world trade semiconductor market attests to the success of Japan's cooperative technology strategy.

The speed with which Japan can put a cooperative industry government group to work on industrial opportunities is actually breathtaking. In September 1981, the information industry committee of MITI's industrial structure council issued a report recommending research and development of a fifth generation computer. Seven months later, in April of 1982, a nonprofit organization was established. Sponsorship came from MITI's electro-technical laboratory, Nippon Telephone and Telegraph, and seven corporations.

I believe everyone in industry would now agree that industrial success accrues not to the leader in basic research, but to the nation that is first to bring a mass produced quality product to the marketplace. Trade competitiveness requires the ability to rapidly deploy civilian technology. In the early 1980s, Japan required seven months to establish the fifth generation computer systems project.

On February 15, 1987, the University of Houston announced a breakthrough in superconductors. The call to Japan supporting this breakthrough came at 3 o'clock in the morning. They got on the telephone immediately. Within 4 days MITI announced its intent to bring together a consortium of Japanese companies, universities and government laboratories. Seven days later—not 7 months, but 7 days later, the consortium was in place with a rumored budget of $300 million.

The Wall Street Journal said Japan's stated objective is to organize industry to get the jump on the West in applications and commercializations for a huge new market.

The picture becomes even grimmer when we examine the trials and tribulations of the yet unborn sematech project and realize that Japanese industry and government were able to come together in the cooperative superconductor project in just seven days.

We must speculate what they did on the eighth day. Either they rested or perhaps they set out to seek new industries to dominate.

The bleakness of the American competitiveness picture is illustrated by recent magazine and newspaper articles. Peter Behr reported in The Washington Post, Kodak, a $10 billion a year leader in photography, has decided not to challenge the Japanese in the commercialization of the electronic camera, but Colby Chandler, Kodak chairman, believes that companies such as Kodak must have technological advantages. Chandler said to compete, American companies will have to find ways to share and pool technology. We desperately—and I want to point out that in more and more articles talking about competitiveness these days, we see the word "desperate."—we desperately need in this country the ability for all of the collective strengths of American industry to be able to work together.

In the same vein, The Los Angeles Times said it takes giants to battle Japan in the chip market. U.S. companies with revenues of $600 million to $1 billion per year do not have the financial resources to keep up with the technology. They cannot compete with cooperative Japanese programs which pool scarce intellectual resources as well as sharing the financial risk.

The current perilous position of the U.S. semiconductor industry and the attendant semiconductor proposal highlights, in my mind, how outmoded American means for deploying commercial technology have become in comparison to our competitors.

It's not that sematech is not important. Sematech is vital to the survival of a critical industry. Unfortunately, there is no existing U.S. institution available to breath life into a sematech on a time table that would allow the U.S. to remain competitive.

The semiconductor industry has come together to seek a cooperative venture with government participation. After the customary review, I assume the proposal will go to the Congress for possible funding. Since there are no suitable U.S. civilian agencies for the development of manufacturing technology, the Congress must look, as it has in the past, to the Department of Defense. Involving the DOD will in turn require a justification of the program in the name of national defense, and thus requires by law a military overlay.

After all other hurdles are cleared, a special antitrust dispensation will be necessary to allow competing companies to come together. The speed of this process, I guess, is best described as being glacial compared to that exhibited by our competitors.

As a sad footnote to the whole sematech matter, a Los Angeles Times article recently questioned the effectiveness of the Pentagon as the patron of civilian technologies. The article reviewed the progress of the DOD, very high speed integrated circuit program that was begun several years ago with a budget of $300 million. It was my understanding that this program was to be a U.S. answer to the original Japanese chip program. DOD's program is now substantially behind schedule, and is projected to cost nearly triple the original estimate. The chips developed to date are reported to offer very limited commercial applicability.

The Congress should realize that the prize Japan seeks is not the chip industry, but the much larger computer industry. Beginning with the takeover of consumer electronics in the 1950s, Japan has successfully applied the same strategy to industry after industry. Excess capacity is built to supply basic materials and components. Predatory pricing drives out U.S. material and component suppliers.

Once dominance is achieved in materials and components, the emphasis is shifted to subassemblies, and this process is repeated until the entire industry falls.

The most telling article that I have read recently dealt not with semiconductors or superconductors, but with our farm industry. Robert Kuttner described the disastrous consequences of incoherent U.S. farm policy. For over 100 years, U.S. agriculture has had a partnership of industry, government, national laboratories and universities. However, in spite of the unquestioned technological competence of U.S. agriculture, incompatible U.S. farm and monetary policies allowed Argentine wheat to be delivered last year in Minneapolis at a price lower than that of wheat grown in Minnesota. Trade competitiveness obviously requires both effective technology deployment and coherent national policy to support and nurture industry.

The list of counterproductive policies imposed upon U.S. industry often appears endless and literally boggles the mind. U.S. industry is handicapped by interest policies and rates that are not competitive with those of Germany and Japan. U.S. capital formation policies are archaic. A Japanese corporation has up to a 9-to-1 advantage over its U.S. counterpart. U.S. tech policies are incompatible and uncompetitive. Monetary policies have distorted exchange rates. Regulatory policies and practices are adversarial instead of cooperative. Educational policy has left us with 20 percent illiteracy. Antitrust laws were created for an internal economy. And finally, inefficient R&D policy practically guarantees that the U.S. will continue to lead the world in both Nobel science award and trade deficits.

Mr. **Brown** [presiding]. Dr. Rosenstein, I hate to interrupt such a wonderful statement, but part of my job is to be sure that we keep on schedule, and if you could move a little more expeditiously, I think we would all appreciate it.

Dr. **Rosenstein**. I was just getting in full voice, George. [Laughter.]

Mr. **Brown**. Do you want to be fair to the others?

Dr. **Rosenstein**. I certainly do.

Well, let me summarize this.

There are four basic institutional elements working together which are necessary for success in the international marketplace.

First, you need an information base to collect, organize, maintain and efficiently disseminate a comprehensive international, domestic data base. You need policy analysis and assessment to analyze and assess policies, opportunities, and policy alternatives, including the impact of foreign initiatives on the nation's competitiveness.

We particularly need mechanisms to facilitate public debate and consensus generation, and we certainly need technology development and deployment institutions, which we don't have today.

I guess I could conclude with a statement that TRW's Pat Choate wrote. He was not able to testify in person today, but I'll read his statement. He said,

> The message that is being sent to Congress and the President by distinguished leaders from business, government, unions, and academia is that government must give more attention to how it forges economic policy and how these policies affect the competitiveness of our nation's economy.

The legislation you are considering is an important step in that process. It provides high level oversight and the mechanisms that are required to collect and analyze information, secure broad, open consideration of views, and translate the analysis into specific policy recommendations for the President and the Congress.

Whether the coordination mechanism is located in the White House or an agency is important but secondary to the fact that such a mechanism is required, and desperately. What is important

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is that your legislation will elevate the issue of trade and competitiveness to a parity with foreign policy and national defense. That has long been needed.

Equally important, your proposal would begin the long overdue process of improving the coherence of Federal decision-making, particularly as it influences the competitiveness of U.S. industry. That, too, has long been needed.

In sum, the legislation you propose is central to any larger national effort to improve America's economic competitiveness.

Thank you.

Mr. **Brown**. Let the record show that Mr. Choate is referring to the National Policy and Technology Foundation Act.

[The bill H.R. 2165, plus the prepared statement of Dr. Rosenstein follow:]

I

100TH CONGRESS
1ST SESSION

H. R. 2165

To advance the national prosperity, quality of life, and welfare, to establish a National Policy and Technology Foundation, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

APRIL 23, 1987

Mr. **BROWN** of California (for himself, Mr. **GEPHARDT**, Miss **SCHNEIDER**, Mr. **BARNARD**, Mr. **BEILENSON**, Mr. **BERMAN**, Mr. **BONIOR** of Michigan, Mr. **COELHO**, Mr. **CONYERS**, Mr. **CROCKETT**, Mr. **DIXON**, Mr. **DYMALLY**, Mr. **FAUNTROY**, Mr. **FLORIO**, Mr. **FISH**, Mr. **FUSTER**, Mr. **GRAY** of Pennsylvania, Mr. **HAWKINS**, Mr. **HUGHES**, Mr. **LEVINE** of California, Mr. **LIPINSKI**, Mr. **LOWERY** of California, Mr. **MCMILLEN** of Maryland, Mr. **MACKAY**, Mr. **ROBINSON**, Mr. **SAXTON**, Mr. **TORRES**, Mr. **UDALL**, Mr. **WAXMAN**, and Mr. **WOLPE**) introduced the following bill; which was referred to the Committees on the Judiciary and Science, Space, and Technology

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A BILL

To advance the national prosperity, quality of life, and welfare, to establish a National Policy and Technology Foundation, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "National Policy and Technology Foundation Act of 1987".

SEC. 2. FINDINGS.

(a) POLICY AND CHANGE.—The Congress finds and declares that—

(1) The United States has entered the fourth decade of a long term economic, relative life quality, and trade competitiveness decline that has persisted under the stewardship of both parties and a wide range of micro and macro policies.

(2) The absence of consistent, rational, nationally visible and accepted public policy is adversely affecting the Nation's life quality, industrial competence, and trade competitiveness, all of which are a direct consequence of the composite of national micro and macro policies that are now created independent of each other and to a large extent in ignorance of their collective effect upon the national well-being.

(3) The Nation does not have a lack of national policies of all types, including economic, societal, industrial, tax, financial, fiscal, monetary, trade, educational, and other policies, but in fact the United States has too many inconsistent, uncoordinated, contradictory, incompatible, and too frequently mutually canceling policies.

(4) The national policymaking process is largely reactive and incapable of satisfying the rapidly changing requirements of a modern nation. The long term

decline in international trade competitiveness is recognized only after much of American industry has been driven offshore and runaway trade deficits have made the United States a debtor nation for the first time in 70 years.

(5) The United States does not possess means for rationalizing national policy, anticipating changing conditions, assessing the long-term consequences of existing and proposed public-private policy, and providing a self-consistent and highly visible national policy structure.

(6) Congress and the President do not have means to effectively resolve increasingly complex issues involving large sectors of the society with legitimate but conflicting interests. Gramm Rudman Hollings and the loss of industrial competitiveness are only two critical manifestations of the more fundamental national policy-making problem.

(7) Institutional limitations frequently force consideration of short term simplistic policies such as trade protectionism without also providing the longer term policies required to maintain international competitiveness.

(8) Much of the success of the trading partners of the United States can be traced directly to the policy-

proposing institutions which they have established for cooperatively assessing long-term national needs, creating national policies in the public interest, and obtaining the consensus necessary for policy facilitation. Japan's Ministry of International Trade and Industry (MITI) is an outstanding example.

(9) In the absence of coherent, integrated, mutually compatible national policy, American industry has become disadvantaged with respect to its trade competitors in essentially every important determinant of trade competitiveness.

(10) From workforce education to capital availability, technology deployment, interest rates, and regulatory practices, etc., the disincentives to retaining a United States manufacturing presence outweigh the incentives.

(11) Nations fail when they are unable to accommodate change. Yet America's policy institutions are no longer flexible enough to adapt to a rapidly changing future.

(12) Basic research, technological innovation, industrial competence, and international trade competitiveness are four distinct areas with different personnel, philosophies, techniques, and other attributes, and most

importantly, they respond to entirely different national policies and incentives.

(13) Industrial competence and success in international trade competition are more dependent upon the collective effects of national policy (including tax, capital formation, antitrust, property, economic, financial, monetary, saving, education, intellectual, and other policies) than upon basic research or technical innovation. The latest production equipment, production methods, and scientific knowledge can be imported at small cost.

(14) While half of all actions taken by business are in direct response to the decisions of the Government, Government policymaking has not kept pace with this reality.

(15) Centralized planning is not effective or viable nor is Government-dominated public policy formulation acceptable.

(16) The disincentives created by incoherent national policy and the disadvantages stemming from outmoded uncompetitive means for developing and deploying technology are seldom addressed by existing institutions and therefore remain unresolved. United States industry will continue to be disadvantaged and outclassed until the Nation modernizes its institutions to

give American industry national policy and technology support comparable to that available to their competition.

(17) The United States needs a highly visible public policy process bringing together all sectors of the society to cooperatively and continuously formulate, evaluate, propose, and facilitate national policy in the long term public interest.

(18) To insure long term success the national policy mechanism will require—

(A) a high quality comprehensive readily accessed international and domestic information and data base;

(B) first rate, independent capabilities for the analysis of national problems and opportunities and the assessment of policy alternatives—their interdependence and interaction;

(C) highly visible societally representative means for achieving national policy consensus; and

(D) means to facilitate and implement those policies for which there is no presently existing suitable organization including in particular trade competitiveness and the creation and deployment of civilian technology.

(b) WORLD TRADE AND COMPARATIVE ADVANTAGE.—

(1) The standard of living of the Nation must ultimately depend upon the maintenance of an export manufacturing and service base providing enough "value added" exports to balance the cost of imports.

(2) World trade rules are being rewritten every day. With continuously changing world markets and international competition that changes its policies and strategies to match the changing market, the United States must be able to reshape its policies and institutions for compatability with the changing times.

(3) International competition is forcing the unmanning of the factories of the United States and other industrialized nations at an accelerating rate. By the year 2000 manufacturing will have joined agriculture as a vital part of the economy that will no longer be a major source of jobs.

(4) Comparative trade advantage can no longer be maintained by controlling technology and capital. Modern technology and capital are completely mobile.

(5) Automation and computerization are removing most of the comparative advantage of cheap labor, leaving competitive success to hinge upon other national comparative advantages such as resources (institu-

tions, intellectual, educational, land, energy, materials, information), national policy compatability and consistency, infrastructure, market, etc.

(c) SOCIETAL ROLES.—Adversarial vs. Cooperative—

(1) Ours is a hybrid society, part free enterprise and part government-controlled, with an increasing need for a cooperative partnership of government, business, university, labor, and the professions in the public interest with each sector making its appropriate contribution.

(2) Confusion of the roles of government, the private sector, university, labor, and the professions has contributed to the creation of an adversarial society, often with undercooperation and excessive regulation.

(3) Other developed nations generally have closer government, industry, education, and professions cooperation than does the United States, particularly in the foreign trade arena. With the increasingly global trade patterns that accompany world development and the penetration of United States markets by foreign competitors, the United States will have to provide for closer government, industry, labor, education, and professions cooperation in order to compete successfully.

(4) To ensure a healthy national society and economy there is a need to forge closer links among sectors

of society in the arena of technology and the professions. Improved links among government, industry, labor, academia, and the professions are essential. Many new discoveries and advances in theory and practice occur in universities and government laboratories while dissemination and utilization of these advances for commercial and useful public purposes depends largely upon actions by business, labor, and other parts of government.

(5) Adversarial societies, with government, industry, labor, education, and the professions each trying to maximize individual returns instead of the total quality of life have proven to be less effective than societies which encourage a cooperative partnership of these basic elements.

(6) The performance of both the National Science Foundation, which is managed by the country's science community, and the agriculture extension system that draws upon education and the farm industry, demonstrates that cooperative mechanisms can be created in the national interest which will not be dominated by the Federal Government or exercise excessive government control. In these areas, government provides incentives and long-term support while policy, direction, and operation comes from the society.

(d) POLICY INFORMATION AND STATISTICS.—

(1) United States public and private policymaking and resource allocation are hindered by the lack of a readily accessed high quality comprehensive domestic and international information and statistics collection, organization, and dissemination system.

(2) United States' trade competitors often possess more detailed and current knowledge of United States markets and industrial activities than is available to our own decision makers.

(3) The President's Commission on Industrial Competitiveness observed: "One reason few United States firms export is that they lack critical information about foreign markets. Such information currently exists within Government, but it is not readily available.".

(4) A modern nation is not well advised to leave at stake so much of its future—its industrial competence, trade competitiveness, and national life quality—with the inadequate means that the United States possesses to obtain advance warning of pending problems and with so little depth of information with which to assess alternatives.

(5) The Grace Commission has pointed out that the United States spends enormous sums of money

upon obsolete information systems that serve only limited national needs. A properly designed national information system is expected to offer substantial savings.

(6) Half or more of the good ideas in technology, the professions, and science will originate outside the United States. Our ability to utilize these ideas to our advantage will depend to a great extent on our alertness and ability to bring in, adapt to our needs, and disseminate the advances that start outside our boundaries.

(e) ANALYSIS, EVALUATION, AND ASSESSMENT.—

(1) The United States does not possess adequate mechanisms to—

(A) monitor and analyze the Nation's life quality or the health of its industry and technology; or

(B) evaluate the effect of United States and foreign government industrial, technological, and trade policies in order to identify weaknesses and potential comparative advantage at an early stage and assess the likely future impact on America's producers and workers.

(2) Government policies in areas such as antitrust, finance, economics, information gathering and distribution, labor, trade, patents, procurement, regulation, re-

search and development, small businesses, and taxes have significant impact upon the economy, trade competitiveness, and the national life quality, but there is insufficient knowledge of their interaction and their effects upon the Nation.

(3) There presently are no adequate means to measure the quality of life in the Nation or to predict the impact upon the Nation of new domestic or foreign developments in education, medicine, science, business, law, technology, social institutions, and other areas.

(4) The President's Commission on Industrial Competitiveness found: "The competitiveness issues facing America today are not new, yet they remain unsolved. The ability of the political decisionmaking process to deal with them is impeded by conflict among the very sectors needed to solve the problems we face. Policymakers must deal with widely disparate points of view presented by a diversity of interested parties. Often there is not even agreement as to the facts of the issue much less a shared understanding of the tradeoffs in the policy operations under discussion.".

(5) There is a need to arrange for objective tradeoff analyses to balance out public benefits versus risks in our policy selection process. United States public institutions are not properly organized to weigh our

modern technological society's options, compare the benefits and disbenefits, and then offer timely balanced national policies.

(6) Emerging national problems frequently receive inadequate attention in the executive branch of the Federal Government because existing agencies have existing missions and little incentive to extend themselves beyond those missions. An agency charged with identifying emerging national problems, studying them, and recommending policies and programs to address them is needed.

(f) CONSENSUS.—

(1) While our national life quality and economy benefit when business, labor, government, academia, professions, and public interest groups work together cooperatively, there exist no effective, publicly visible, high level forums for developing consensus on national policies.

(2) The leading United States trade competitors have well-established institutionalized means for obtaining policy consensus. Japan's MITI has 35 associated independent councils with over 200 standing committees that reach every walk of Japanese life.

(3) While other nations develop national strategies aimed at reducing the United States' market share in

targeted sectors and enhancing their own, there exists no forum designed to develop long-term responses to such strategies and to build the public consensus necessary to implement such responses.

(4) The President's Commission on Industrial Competitiveness stated: "Government can be strengthened significantly by providing a forum in which consensus can be reached on the facts of an issue and in which implicit tradeoffs among public options can be made explicit, . . . Consensus is vital. The need for finding consensus on the National level is acute.".

(g) POLICY IMPLEMENTATION AND FACILITATION.—

(1) Advanced nations use a wide range of institutions, laboratories, associations, and other entities that are not available in the United States to facilitate economic, life quality, and trade competitiveness policies.

(2) Implementation of important United States national policies may languish for lack of an existing governmental agency that will pursue or facilitate them.

(3) Industrial development programs crucial to our international competitiveness such as very large scale integrated circuits have been given a military overlay to justify Defense Department sponsorship since there is no concerned competent civilian agency to implement badly needed technological advances.

(4) Although the Federal Government now provides substantial support for science and technological support for selected industries such as agriculture, aviation, and commercial fisheries, the Nation presently lacks the institutional capacity to focus programs on the competitive performance of our economy as a whole.

(5) The President's Commission on Industrial Competitiveness wrote: "we should be concerned by the fact that the Federal Government conducts its R&D . . . in agencies and organizations with no common management. Each research entity has a mission independent of the others and none has industrial competitiveness as a goal.".

(h) INSTITUTIONAL DEVELOPMENT.—

(1) Cooperative government, industry, university, and professions research and development efforts are needed in areas of substantial national interest where sufficient development cannot be expected from private enterprise alone due to high risks, long lead times, or the magnitude of the resources required.

(2) Cooperative efforts in the matter of government-mandated health, safety, and environmental regulation could improve effectiveness and efficiency and reduce cost.

(3) The national regulatory process could be improved by requiring responsible regulatory bodies to provide suitable cost/benefit and risk analyses.

(i) HUMAN RESOURCES.—

(1) The Nation has not given adequate attention to its long-term requirements for professional scientific and technical personnel.

(2) The United States has no comprehensive policy or commitment to ensure training or retraining of adequate supplies of properly educated professionals, scientists, and technicians for emerging fields important for the national welfare.

(3) Underutilization of women and minorities in the Nation's professions represents a significant loss of intellectual resources that is not in the national interest.

(j) SMALL BUSINESS.—

(1) The potential of small business for technological innovation and the creation of new jobs is great but has been inadequately realized, largely through the inattention of government.

(2) Small and mid-size businesses are frequently disadvantaged by inadequate access to advice, support, and expert consultation upon matters such as the latest manufacturing processes, management systems, quality

assurance methods, production techniques, computer applications, financial controls, and extension services.

(k) THE PROFESSIONS.—

(1) The problems of the Nation are characterized by their demand for multiprofessional solutions.

(2) It is in the nature of societal advancement—i.e., improvement of the many environments that provide the national life quality—that most fields of endeavor require assembling interdisciplinary-multiprofessional talents, involving a combination of knowledge and experience in various fields. A systems solution of a problem or need will win out over segmental attacks.

(3) The public professions, acting in a coordinated manner, can make important contributions to the solution of national problems.

(4) The collective expertise of the public professions is capable of providing methods for measuring, projecting, and improving the quality of life in the Nation.

(5) It has proven impractical for the National Science Foundation with its responsibility for basic research to also effectively discharge the national problem-solving, resource allocation, technology deployment, and quality of life responsibilities of the public professions.

(l) DESIGN.—

(1) The increasing complexity of human needs, depletion of national resources, and expanding population place an increased burden upon the environment, and the rapid development of technology makes excellence in design of high quality, reliable products and systems a necessity.

(2) The increased demand for United States products and systems resulting from the promotion of excellence in design will stimulate expansion of the Nation's trade and will result in increased employment opportunities for United States citizens.

SEC. 3. PURPOSE.

It is the purpose of this Act to establish a National Policy and Technology Foundation that will provide flexible, efficient, cost effective means to—

(1) improve and facilitate the national policymaking process in the interest of enhanced national life quality, economic performance, and trade competitiveness by—

(A) developing and maintaining the requisite high quality comprehensive, readily accessed international and domestic information, and data base;

(B) providing first rate capabilities for the analysis of national problems and opportunities, the assessment of policy alternatives—their independence and interaction, and the generation of suitable early warnings;

(C) creating through highly visible, societally representative independent councils, public forums where leaders from industry, labor, government, academia, the public professions, public interest activities, and other concerned parties will—

(i) develop and maintain a vision of the succeeding decade with attention to the desired quality of life and the economic, societal, industrial, environmental, trade competitiveness, performance necessary for its achievement;

(ii) create a broad public consensus in support of the desired national life quality goals; and

(iii) openly debate, redefine, and make recommendations to the Congress and the President upon national policy issues with attention to—

(I) their cumulative effect upon mid- and long-term life quality, econom-

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ic performance, and trade competitiveness;

(II) policy coherence and compatability;

(III) equitable distribution of sacrifices and benefits among all of the legitimate but frequently conflicting interests in order to create the broad public consensus conducive to legislation of coherent, integrated national policy in the long term national interest;

(2) reduce the handicaps and disincentives faced by American industry by developing—

(A) cooperative public-private efforts among industry, government, university, labor, and the national laboratories for the advancement and deployment of technology critical to the Nation's trade competitiveness, industrial competence, and life quality;

(B) rationalization of the Government's regulatory processes with cooperation of industry, academia, and national laboratories to improve the technology required to satisfy Government regulation and ensure adequate cost/benefits; and

(C) improvement of the information, technology, and manufacturing resources available to United States small business.

SEC. 4. DEFINITIONS.

As used in this Act—

(1) the term "Foundation" means the National Policy and Technology Foundation established by section 5;

(2) the term "Director" means the Director of the Foundation;

(3) the term "Board" means the National Policy and Technology Board established by section 7;

(4) the term "Councils" means the Councils appointed under section 10 to advise the Director and the offices of the Foundation;

(5) the term "technology" means not only machinery, electronics, tools, chemicals, etc., but ideas which advance human capabilities, and also the structure and management of the human organization of our society;

(6) the term "public profession" means a body of persons engaged in a calling which (A) requires specialized knowledge; (B) may require extensive educational preparation; (C) has a significant relationship with public affairs, the allocation of national resources,

the deployment of technology, and the totality of environments which determine the national quality of life; (D) is accountable to constituencies and the public; and (E) includes but is not limited to accounting, architecture, criminology, dentistry, education, continuing education, engineering, finance, journalism, law, management, medicine, mental health, nursing, pharmacy, public administration and legislation, public health, social welfare, and urban planning;

(7) the term "institution of higher education" means a college, university, or school in any State or foreign country which—

(A) admits as regular students only individuals having a certificate of graduation from a school providing secondary education or the recognized equivalent of such a certificate;

(B) is legally authorized within such State or foreign country to provide a program of education beyond secondary education;

(C) provides an educational program for which it awards a bachelor's degree or other degree, or provides not less than a two-year program which is acceptable for full credit toward a bachelor's degree;

(D) is a public or other nonprofit institution; and

(E) is accredited by an accrediting organization or association determined by the Foundation to be a reliable authority as to the quality of training offered;

(8) the term "agency" means any Federal executive agency; and

(9) the term "State" means the several States, the District of Columbia, the Commonwealth of Puerto Rico, the Trust Territory of the Pacific Islands, and any other territory or possession of the United States.

SEC. 5. ESTABLISHMENT OF THE NATIONAL POLICY AND TECHNOLOGY FOUNDATION.

(a) There is hereby established in the executive branch of the Federal Government an independent agency to be known as the National Policy and Technology Foundation.

(b) There are hereby established in the Foundation—

(1) a National Policy and Technology Board, to function in accordance with section 7;

(2) an Office of Director of the Foundation, to function in accordance with section 8;

(3) a National Information Office;

(4) an Office of National Policy, Analysis, and Assessment;

(5) an Office of National Programs;

(6) an Office of the Professions;

(7) an Office of Institutional and Human Resource Development;

(8) an Office of Small Business; and

(9) an Office of Intergovernmental Technology and Professions Delivery Systems.

(c) There are hereby transferred to the Foundation—

(1) the National Bureau of Standards of the Department of Commerce;

(2) the Patent and Trademark Office of the Department of Commerce;

(3) the National Technical Information Service of the Department of Commerce;

(4) the Office of Small Business Research and Development of the National Science Foundation;

(5) the Directorate for Engineering of the National Science Foundation;

(6) the Division of Industrial Science and Technological Innovation (exclusive of the nonengineering programs of the industry/university cooperative research projects program element) of the National Science Foundation;

(7) the Intergovernmental Programs section of the National Science Foundation;

(8) the Office of Industrial Technology of the Department of Commerce (as established under section 5 of the Stevenson-Wydler Technology Innovation Act of 1980);

(9) the Center for the Utilization of Federal Technology of the Department of Commerce (as established by section 11(d) of such Act); and

(10) the Division of Policy Research and Analysis of the National Science Foundation;

(11) all functions of the Secretary of Defense which relate to the sale of Government information to the public and which are carried out by such Secretary through the Defense Technical Information Center of the Department of Defense;

(12) all functions of the Secretary of Energy which relate to the sale of Government information to the public and which are carried out by such Secretary through the Office of Scientific and Technical Information of the Department of Energy;

(13) all functions of the Administrator of the National Aeronautics and Space Administration which relate to the sale of Government information to the public and which are carried out by such Administrator; and

(14) all functions of the Public Printer which relate to the sale of Government information to the public including functions relating to the sale of such information which are carried out through bookstores operated by the Public Printer.

(d) There are hereby transferred to the Foundation all the functions, powers, duties, and authorities of the National Science Foundation and the Secretary of Commerce under the Stevenson-Wydler Technology Innovation Act of 1980.

SEC. 6. FUNCTIONS OF THE NATIONAL POLICY AND TECHNOLOGY FOUNDATION.

(a) The Foundation, through the National Information Office, shall—

(1) in coordination with existing public and private systems and in cooperation with the Office of Policy, Analysis, and Assessment and appropriate councils, develop and recommend to the Congress and the President coherent National Information and Statistics Policy directed to fuller and more efficient utilization of existing information systems and the meeting of presently unfulfilled national information needs including the information required for informed public and private policy formulation;

(2) in cooperation with other public and private agencies and the National Office of Policy, Analysis,

and Assessment, develop comprehensive computerized National Information and Statistics Data Banks to be made readily accessible to Federal, State, and local governments, business and industrial concerns, educational institutions, and other interested individuals and organizations;

(3) in cooperation with the professional societies, the appropriate agencies of the Federal Government, and the National Office of Policy, Analysis, and Assessment, develop improved indicators of the quality of national life;

(4) provide means for data collection and measures for utilization under paragraph (5) of the basic factors which impact and influence the national life quality and trade competitiveness, including—

(A) United States and foreign government and business policies; national economies; economic, financial, and monetary policies; current and future economic trends; industrial policy and strategy; current and future industrial trends, and market opportunities;

(B) United States and foreign managerial and technological advances;

(C) United States and foreign technological innovation, patent and patent trends, industrial competence and productivity, and international competitiveness; and

(D) United States and foreign educational policies and resource allocation strategies;

(5) insure the development and maintenance of readily accessed, current, comprehensive, computerized information and data banks for public and private policy making which shall include the matters described in paragraph (4) to the extent possible and—

(A) an electronic bibliographic data base of all information collected along with such other records, libraries, and compilations as may be necessary or appropriate, utilizing the best available technology for the purpose;

(B) world trade and market statistics, data, and trend indicators;

(C) world economic indicators—national accounts, labor, prices, etc.;

(D) world financial statistics;

(E) world raw materials and energy production, consumption, trade, and resources;

(F) world technology, industrial competence, productivity, and professions delivery systems;

(G) world patents;

(H) world industrial production and consumption;

(I) United States sectorial data;

(J) United States pollution level records;

(K) United States and foreign major enterprise reports;

(L) United States city and town data, including population, industrial and commercial activity, finance, culture; and

(M) institutional and human resource requirements;

(6) provide for greater dissemination, access, and utilization of the above data banks through an on-line national computer network and other suitable means for public and private users including small and large business, State and local government, Federal agencies, labor, the professions, industry, academia, the general public, media, and others;

(7) make such information available on reasonable terms and conditions and upon payment of reasonable fees and charges;

(8) provide means to allow users to retrieve, tabulate, and analyze Government data including policy information data through terminals with powerful application software to include—

(A) retrieval and edit;

(B) tabulation;

(C) graphics;

(D) analysis including matrix algebra, time series analyses, input output analyses, etc; and

(E) econometric model building and simulation;

(9) review the Government's existing information collection and dissemination functions and facilities in order to recommend improvements, avoid duplication, and implement maximum utilization; and

(10) to the maximum extent possible collect and make available the foreign data of paragraphs (5) and (6) utilizing where appropriate—

(A) data exchange agreements with foreign information offices; and

(B) suitable offshore offices to—

(i) collect suitable data; and

(ii) monitor, abstract, and translate important articles from the journals of the host nation, in coordination with the National Technical Information Service and other relevant agencies.

(b) The National Technical Information Service of the Department of Commerce, including all functions of the

Center for the utilization of Federal technology, and the functions which relate to the sale of Government information to the public of the Defense Technical Information Center of the Department of Defense, the Office of Scientific and Technical Information of the Department of Energy, the Scientific and Technical facility of the National Aeronautics and Space Administration, and the Public Printer shall become part of the National Information Office and shall—

(1) provide a full array of information and statistical services regarding inventions, technical information, products, processes, research, and development from the Federal laboratories and agencies as well as foreign advancements;

(2) act as a repository of all scientific and technical information collected by Federal agencies, including information on technical innovation processes and foreign manufacturing technologies and including all information developed or received by the Federal agency in connection with research, development, or analysis performed or sponsored by that agency (including information obtained or received pursuant to research, development, or analysis contracts), such information to be provided without cost to the Office;

(3) act as a distributor of such information for a Federal agency under any agreement entered into by the Office with the agency;

(4) operate a clearinghouse for data relating to technological innovation and industrial competence to coordinate available information resources in the private sector;

(5) promote technology transfer from the Federal Government to private enterprise and assist the Office of Intergovernmental Technology and Professions Delivery Systems in promoting technology transfer to State and local governments; and

(6) develop and maintain an organized reporting of information on the historical, legal, technological, commercial, and professions aspects of design (including reliability and quality) in the United States and foreign countries and make this information available for use by the public and private sectors.

(c) The Foundation, through the National Office of Policy, Analysis and Assessment, shall—

(1) in cooperation with the National Information Office, professional societies, and the appropriate agencies of the Federal Government, develop improved indicators of the quality of national life along with measures of those factors such as technological innovation,

industrial competence, productivity, and international competitiveness which contribute to the national well-being;

(2) in cooperation with the appropriate Councils, establish a coordinated multidiscipline-multiprofessions effort with full participation of industry, labor, public interest activities, academia, the professions, the Federal Government, and other concerned parties, to—

(A) monitor the changing nature of the United States' economy, quality of life, and capacity to—

(i) provide marketable goods and services in domestic and international markets; and

(ii) respond to international competition;

(B) monitor and assess international and technological, scientific, managerial advances and policies and strategies that might impact the United States; and

(C) monitor and maintain public records regarding the effect of imports on United States industry;

(D) serve as an early warning system to identify emerging national problems, opportunities, and needs including those of industry, technology, and the professions that are not adequately resolved by other public and private institutions;

(E) formulate for public review and debate by the appropriate Councils and submit possible recommendations to the Congress and the President policies and programs to properly resolve such problems and needs; and

(F) present at regular intervals of not more than 10 years an emerging problems and opportunities analysis for national review and comment in order to develop a national vision of the succeeding decade, with such analysis drawing upon the ongoing and systematic critical trends assessment program;

(3) develop methods to assess existing and proposed programs and policies of the government, industry, labor, and the public professions with a view toward—

(A) forecasting the impact of such programs and policies upon the mid- and long-term quality of life and trade competitiveness of the Nation, and

(B) suggesting, whenever necessary, alternative programs, policies, and resources to attain improved quality of life and trade competitiveness,

(4) study and determine the relationship (including interrelationships) of national economic, industrial, societal, and life quality policies to United States technological development and deployment, industrial competence, international competitiveness, and the Nation's standard of living;

(5) evaluate and assess the impact of existing and alternative United States and foreign government and business policies and programs upon technological development and deployment, industrial competence and sectorial productivity, international competitiveness, and the national quality of life, including—

(A) macro- and micro-economic policies and trends;

(B) financial, savings, tax policies;

(C) industrial structure, management, and policies;

(D) foreign technological, industrial, and economic targeting strategies and tactics;

(E) education structure and policies;

(F) labor policies including retraining; and

(G) professions programs and policies;

(6) in cooperation with the appropriate Councils, study and determine the mid- and long-term potential national comparative advantages in industry and serv-

ices which the United States possesses by reason of its natural, financial, human, intellectual, industrial, market, infrastructure, and other resources with a view toward determining—

(A) the public and private policies needed to realize a comparative advantage potential;

(B) the resource commitments required to attain market share; and

(C) the attendant risks;

(7) conduct analysis and assessments, including studies of the effects of technology and the professions upon the past, present, and future quality of national life;

(8) determine the relationships of technological and professional developments and deployment, and international technology transfers to the output, employment, productivity, and world trade performance of the United States and foreign industrial sectors;

(9) identify technological and professional needs, problems, and opportunities within and across industrial sectors that, if addressed, could make a significant contribution to the economy of the United States;

(10) assess whether the Nation's resource allocation policies, including the capital, human, technical, and other resources being allocated to domestic indus-

trial sectors, are adequate to meet private and social demands for goods and services, promote productivity and economic growth, and insure adequate international trade competitiveness;

(11) in cooperation with concerned public and private agencies, formulate for national review and debate by the appropriate Councils and subsequent possible recommendation to the Congress and the President of mid- and long-range national policies, with attention given to—

(A) industries and services where the United States can develop or retain a significant comparative trade advantage;

(B) industries of the future whose early implementation will affect the national prosperity and life quality;

(C) the identification and promotion of the basic technology and research and development necessary to support comparative advantage industries and services and the next generation of new industry, such as biotechnology;

(D) the development of basic fields common to all industries such as new materials and information systems;

(E) mechanisms for promotion and support of long-term industry, labor, university, professions and government partnerships, including the national laboratories;

(F) areas where government aid should be considered when sufficient technological development cannot be expected from private enterprise due to high risks, long lead times, and the sheer magnitude of the investment, with government support in principle being given only to research and development programs with commercialization and new technology diffusion the responsibility of individual companies;

(G) tax, financial, savings, and investment incentives;

(H) the identification of causes of decline in economic segments and weaknesses at an early stage in the health of domestic industries with the goal of proposing policies and strategies to reverse the trend;

(I) declining and troubled industries with significant impact upon the national economy or local regions;

(J) the amelioration of the negative societal and employment impact of economic and technological change;

(K) industrial structure, organization, location, and environmental impact;

(L) innovation, productivity (including sectorial productivity) industrial competence, and international competitiveness;

(M) the promotion of standardization;

(N) maximizing the ability and effectiveness of private enterprise, including cooperative and not-for-profit institutions; and

(O) the encouragement of private technology development efforts including subsidies where appropriate to stimulate the development of critical technology;

(12) cooperate and coordinate with other policy bodies of the Federal, States, and local governments;

(13) assess and evaluate national policies in the interest of the national welfare, stable development of the economy, trade competitiveness, and quality of life for those areas where a formal policy mechanism does not exist or present policies are inadequate and, where appropriate, formulate policy questions and proposals for review and debate by the Councils;

(14) propose policies to actively promote cooperative rather than adversarial public and private sector relations and policy development;

(15) propose and support studies and policy experiments in cooperation with other Federal agencies, to determine the effectiveness of measures which have the potential of advancing and deploying United States technological and professions innovations;

(16) recommend to the Director, for transmission to the President and Congress, government measures with the potential of advancing and deploying United States technological and professions innovation and exploiting innovations of foreign origin;

(17) carry out the programs transferred to the Foundation by section 5(c)(10);

(18) in cooperation with the Office of Institutional and Human Resource Development, develop long-term national professional and technological human resource policies to guide where private and Federal funds (including training and retraining funds) would be best employed to insure the Nation's well-being;

(19) in cooperation with the Office of Science and Technology Policy and the National Endowment for the Humanities, establish a program for improving the use of risk analysis and decision theory and other fore-

casting methods by Federal agencies concerned with regulatory decisions and national resource allocation;

(20) in cooperation with the Office of Small Business, develop policies and programs to materially improve the resources and capabilities of United States small enterprise;

(21) in cooperation with the National Information Office and appropriate councils, develop and propose for national review and implementation a coherent, comprehensive National Information Policy;

(22) in cooperation with the National Information Office and its other offices and with the advice and recommendations of the Councils, provide at intervals of not more than 10 years a comprehensive analysis and evaluation of the functioning of the Foundation and its effectiveness in anticipating and meeting national problems, including a comparative analysis with similar institutions in other countries, and then submit to the Congress a plan for Foundation renewal or termination;

(23) either directly or through grants, loans, or other assistance, conduct studies and evaluations of the operation of the public professions, the delivery of services by the public professions, and the manner in which

governmental agencies use the services of public professions; and

(24) develop and encourage the pursuit of a broadly conceived national professions policy which supports the national interest and a plan for the periodic updating of such policy.

(d) The Foundation, through the Office of National Programs, shall—

(1) in cooperation with the National Office of Policy, Analysis, and Assessment, identify emerging national problems, opportunities, and needs, including those of industry, technology, and the professions, that cannot be adequately satisfied by other public and private institutions;

(2) implement development and applied research policies and programs for those areas of substantial national concern which the Congress believes are not adequately served by other agencies and where sufficient development cannot be expected from private enterprise alone due to high risk, long lead times and/or the magnitude of the financial or intellectual resources required;

(3) establish coordinated multiprofessions efforts with full participation of industry, government, labor,

academia, and representatives of public interest groups to—

(A) determine the approaches, resources, and priorities required to implement the policies and programs described in paragraph (2) and encourage and facilitate cooperative government, industry, labor, education, and professions programs, including basic technologies common to all or many industries and the development of solutions either through the National Bureau of Standards or the National Laboratories or by extramural grants and contracts to the universities and industry;

(B) address issues common to all industries including pollution and location; and

(C) remove the barriers including critical technological advances that prevent the early encouragement of industry for the future or the orderly retirement or renovation of declining industry;

(4) support extramural development and applied research which falls outside the purview of other Federal agencies and which in the opinion of the Congress and the President should be supported in the national interest;

(5) carry out the problem-focused programs, other than intergovernmental programs, centers programs, engineering programs, and small business programs, which are transferred to the Foundation under section 5; and

(6) cooperate with other Federal agencies to facilitate national and regional plans and policies for declining or less competitive industries important to the national welfare.

(e) The Foundation, through the Office of the Professions, shall—

(1) carry out the engineering programs transferred to the Foundation by section 5(c)(5), and establish an Engineering Directorate within such Office.

(2) support applied research and development in engineering disciplines not adequately supported by other sources of funding, and support fundamental research in all engineering disciplines;

(3) support applied research and development in disciplines of other professions not adequately supported by other sources of funding;

(4) establish, through grants, loans, and other assistance, programs of investigation and applied research designed to understand and facilitate the cooperative mechanisms necessary to replace existing ad-

versarial relationships with productive public-private partnerships of industry, labor, university, the public professions, and government for the solution of national problems, and further (where appropriate) closer cooperation with local, State, and Federal agencies.

(5) provide for seminars, conferences, and lectures to promote public and professional understanding of the public resource allocating and environmental decision making role of the professions and the need for cooperation among government, industry, university, labor, and the professions to counteract the present unproductive adversarial relationships; and

(6) develop and implement a program of development and applied research directed at strengthening the knowledge base and methodology required to support government agencies in utilizing risk analysis, decision theory, and other forecasting methods in regulatory and resource allocation decision making, including cooperative development and applied research to be undertaken with the Endowment for the Humanities to develop methodology for the determination of socially acceptable risks and value systems.

(f)(1) The Foundation, through the Office of Institutional and Human Resource Development, shall—

(A) in cooperation with the Office of National Policy, Analysis, and Assessment, recommend long-term national professional and technological human resource policies to guide where private and Federal funds would be best employed to insure the Nation's well-being, including policies providing for—

(i) establishing a national council on professional, technical, and scientific manpower;

(ii) establishing and maintaining the necessary means for identifying and assessing the mid- and long-term professions, technical, and scientific human resource needs necessary for the well-being of the Nation, with recommendations for policies and programs necessary to meet these needs (including such resources as personnel, institutions, equipment, facilities, and funding);

(iii) assisting in the preparation of such long-range technical human resource assessments and policy recommendations as are required or authorized by the National Science and Technology Policy, Organization, and Priorities Act of 1976 (42 U.S.C. 6601 et seq.); and

(iv) assessing the mid- and long-term effects of technological change and the unmanning of the Nation's factories upon human resource requirements, with recommendations for training and retraining policies and programs;

(B) encourage and support public professions and technical training and educational institutions, which may include, but need not be limited to—

(i) establishing, operating, or providing funding for such training and educational institutions, including libraries;

(ii) providing grants, loans, or other assistance to individuals;

(iii) developing professions curricula or training programs in anticipation of national needs including that required to advance the Nation's industrial competence and international competitiveness; and

(iv) encouraging and providing assistance for minorities and women to enter the professions;

(C) encourage the temporary exchange of professional personnel between academia and industry to promote the purpose of this Act set forth in section 3; and

(D) carry out the functions, powers, duties, and responsibilities transferred by section 5(d) with respect to providing assistance for the establishment of Centers for Industrial Technology and Design and the programs of such Centers transferred by sections 5(c)(6) and 5(c)(8), in order to enhance technological and professional innovation, industrial competence, and international competitiveness through—

(i) the participation among industry, professions, the Federal laboratories, universities, the Federal Government, and State and local governments in cooperative technology and professions innovation;

(ii) the identification and development of the generic knowledge, technology, and/or methodology base important for technological advances in the quality of life and innovative activity in which individual firms have little incentive to invest, but which may have significant economic importance or application to a wide range of industries such as manufacturing and process technology or pollution control systems;

(iii) facilitate cooperative government, Federal laboratory, industry, labor, university, and professions efforts in the matter of government-mandated health, safety, and environment regulations in order to—

(I) ensure that the regulations are achievable;

(II) develop the basic methodology and technology for satisfying the regulations and minimizing costs of duplicative development and research;

(III) apply comparative risk analysis, decision theory, and other forecasting methodologies to regulation formulation to ensure a societal return comparable to the societal investment;

(IV) educate professionals in the required technology; and

(V) encourage innovation in satisfying regulations;

(iv) the education and training of individuals in professional and technology innovation;

(v) cooperation with the National Information Office for the improvement of existing mechanisms and the development of new mechanisms in the dissemination of professional, technical, and scientific information between universities, industry, local and State government, and the professions;

(vi) the utilization of the capability and expertise (where appropriate) that exists in Federal laboratories; and

(vii) the development of continuing financial support from industry and universities through, among other means, fees, licenses and royalties.

(2) The activities of the Centers established pursuant to paragraph (1)(D) shall include but need not be limited to—

(A) development and applied research supportive of technology, the professions, industrial innovation and competence, and international competitiveness, including cooperative industry, professions, and university efforts;

(B) the establishment at each Center of leadership in one or more technologies and a corresponding comprehensive development and applied research clearinghouse;

(C) assistance in the evaluation and development of technological ideas supportive of industrial innovation and competence, international competitiveness, and new business ventures;

(D) technological and professional assistance and advisory services to industry, government, and the professions in cooperation with the Office of Small Business; and

(E) curriculum development and instruction in invention, entrepreneurship, professional innovation, and multiprofessional problem resolution.

(3) Prior to establishing a Center pursuant to paragraph (1) the Director must find that—

(A) consideration has been given to the *potential* contribution of the activities proposed within the Center to the productivity, employment, economic competitiveness, and national life quality of the United States;

(B) a high likelihood exists of continuing participation, advice, financial support, and other contributions from the private sector, including industry, labor, and the professions;

(C) the host university or nonprofit institution has a plan for the management and evaluation of the activities proposed within the particular Center, including consideration of means to place the Center, to the maximum extent feasible, on a self-sustaining basis; and

(D) suitable consideration has been given to the proposed geographical location of the Center.

(g) The Foundation, through the Office of Small Business, shall—

(1) in cooperation with the Office of Policy, Analysis, and Assessment, develop, recommend, and implement policies and programs to materially improve the

resources and capabilities of United States small enterprise, including but not limited to—

(A) upgrading the production technology available to small enterprise through grants and incentives for development and research projects including those conducted jointly by industry, universities, and public and private development and research organizations;

(B) training technical, professional, entrepreneurial, and managerial personnel;

(C) promoting computerization and automation in small enterprise for design, manufacture, and management;

(D) advancing and modernizing production capabilities and facilities; and

(E) providing management consultation;

(2) in cooperation with the Office of Institutional and Human Resource Development, establish the technology and professions counterpart of the United States Agriculture Extension System to be known as the Federal Technology and Professions Extension Service, in order to—

(A) provide access by individual, company, industry, profession, and governmental entities to advice, support, and expert consultation, including but not limited to the latest manufacturing processes, management systems, quality assurance methods, production techniques, personnel procedures, professions delivery systems, computer applications, financial controls, and extension services;

(B) coordinate with existing technology, professions, and industrial extension programs to avoid duplication or adverse impact; and

(C) provide grants and loans to carry out technology, professions, or industrial extension plans and programs;

(3) operate programs of grants and contracts for the development and advancement of high-technology small businesses including joint cooperative industry, education, government, development, and applied research;

(4) foster communication between scientific and technological agencies of the Federal Government and the small business community;

(5) collect, analyze, compile, and publish information concerning grants and contracts awarded to small business concerns by scientific and technical agencies of the Federal Government and the procedures for handling proposals submitted by small business concerns;

(6) assist individual small business concerns in obtaining information regarding programs, policies, regulations, and procedures of the Federal Government, and assist such concerns in dealing with the Federal Government;

(7) recommend to the Director for transmission to the President such changes in the laws, procedures, policies and practices of the Federal Government as may be required to enable the Nation to benefit more fully from the resources of high-technology small businesses; and

(8) carry out the programs of the agencies transferred to the Foundation by section 5(c)(4) and the small business programs of the agencies transferred by section 5(c)(6).

(h) The Foundation, through the Office of Intergovernmental Technology and Professions Delivery Systems, shall—

(1) provide staff support for the President's Intergovernmental Science, Engineering, and Technology Advisory Panel;

(2) carry out the intergovernmental programs transferred to the Foundation by section 5(c)(7);

(3) facilitate the integration of professional, scientific, and technological resources into the policy forma-

tion, management support, and program operation activities of State and local governments;

(4) promote technology transfer from the Federal Government and private enterprise to State and local governments;

(5) support and promote the appropriate utilization of technology through organized State and local programs of technology and technology information distribution;

(6) carry out the programs transferred to the Foundation by section 5(c)(9);

(7) study and improve the delivery of services by the professions and the performance of professions delivery systems in government; and

(8) support and facilitate cooperation between government (national, State, county, and city) and university professional schools to make the resources of the universities available to legislators for the regular assessment and evaluation of policies, problems, programs, and issues on a multiprofessional systems basis.

(i) The Foundation, through the National Bureau of Standards, shall—

(1) foster (where appropriate) public-private partnerships involving the Bureau and the Federal laboratories in the development and applied research often

required for implementation of specific policies including trade competitiveness, productivity, pollution, and regulation in the national interest.

(2) in cooperation with other Federal agencies and national non-Federal voluntary standards organization, promote and protect United States interests in international voluntary standardization activities;

(3) provide funding and other necessary support for United States participation in international voluntary standardization activities; and

(4) in cooperation with the Office of Policy, Analysis, and Assessment, other Federal agencies, national non-Federal agencies, and national non-Federal voluntary standards organizations, develop and maintain a long-term public and private comprehensive National Standards Policy.

(j) The Foundation shall create a National Design Reliability and Quality Council which shall—

(1) through its programs, encourage excellence in technological design with emphasis on reliability and quality, educate United States entrepreneurs and government agencies to the value of excellence in design; encourage such entrepreneurs to promote excellence in design in the creation, manufacture, and sale of well-designed objects and systems; and assist other govern-

ment agencies, as their programs relate to the objectives of the Foundation, in developing and encouraging excellence in design in addition to performing their other duties;

(2) establish and publicize standards for excellence in the design of objects and systems, including but not limited to consideration of reliability, quality, energy consumption reduction, health, and the environment; and

(3) consult and cooperate with foreign governments and intergovernmental organizations in collaboration with the Department of State, and with private international organizations which are or become concerned with the encouragement and coordination of increased use of excellence in design, to gain international recognition for design standards proposed by the United States.

SEC. 7. NATIONAL POLICY AND TECHNOLOGY BOARD.

(a) The Foundation shall be operated under the general supervision and policy control of a National Policy and Technology Board which shall consist of (1) 24 members to be appointed by the President, by and with the consent of the Senate, from among persons nominated in accordance with subsection (b), and (2) the Director, to be appointed in accordance with section 8(a).

(b) The persons nominated for appointment as members of the Board—

(1) shall be eminent in the professions and technology, including the fields of labor, entrepreneurship, public policy, management, education, industry, government, invention, patents, and trade and shall be expected to independently represent all segments of society to avoid dominance by the Federal Government;

(2) shall be selected so as to provide representation from minorities, representation of all geographic areas of the Nation, and equitable representation of all professions, with particular attention given to nominees possessing experience and expertise in more than one profession; and

(3) shall be nominated after due consideration of recommendations for nomination made by the Board itself, the national academies, professional societies, business associations, labor associations, and other appropriate organizations.

(c) The term of office of each member of the Board other than the Director shall be six years, except that—

(1) any member appointed to fill a vacancy occurring prior to the expiration of the term for which the predecessor was appointed shall be appointed for the remainder of such term;

(2) any person, other than the current Chairman of the Board, who has been a member of the Board for two consecutive six-year terms shall thereafter be ineligible for appointment during the two-year period following the expiration of the second term; and

(3) of the persons initially appointed, eight shall be appointed for terms ending May 10, 1988, eight shall be appointed for terms ending May 10, 1990, and eight shall be appointed for terms ending May 10, 1992.

(e) The Board shall meet not less than twice annually, at the call of the Chairman or upon the written request of one-third of the members. A majority of the members of the Board shall constitute a quorum. Each member shall be given 10 days advance written notice of each meeting.

(f) There shall be an executive committee of the Board which shall be composed of five members, including the Director, the Chairman of the Board, the Vice Chairman, and two other members of the Board elected to two-year terms by the Board. The executive committee shall exercise such powers and functions as may be delegated to it by the Board.

(g) The Board shall, in addition to any powers and functions otherwise granted to it by this Act—

(1) establish the policies of the Foundation, in accordance with applicable policies established by the President and the Congress;

(2) review the budget of the Foundation;

(3) review the programs of the Foundation;

(4) render to the President, for submission to the Congress, the report required in section 14(a); and

(5) approve or disapprove every grant, contract, or other funding arrangement the Foundation proposes to make, except that a grant, contract, or other funding arrangement involving a commitment of less than $250,000 may be made by the Director without specific Board action, if the Board has previously reviewed and approved the program of which that commitment is a part.

(h)(1) The Board may appoint a staff of not more than five professional staff members and such clerical staff as may be necessary. The professional staff members may be appointed without regard to the provisions of title 5, United States Code, governing appointments in the competitive service, and the provisions of chapter 51 of such title relating to classification, and may be compensated at a rate not to exceed the rate provided for grade GS–18 of the General Schedule under section 5332 of such title.

(2) The Board may establish such special commissions as it may deem necessary for the purposes of this Act.

(i) Members of the Board shall receive compensation when engaged in the business of the Foundation at a rate fixed by the Chairman but not exceeding the daily equivalent of the rate provided for level GS–18 of the General Schedule under section 5332 of title 5, United States Code, and shall be allowed travel expenses as authorized by section 5703 of title 5, United States Code.

SEC. 8. DIRECTOR OF THE FOUNDATION.

(a) The Director of the Foundation shall be appointed by the President, by and with the advice and consent of the Senate. Before any person is appointed as Director, the President shall afford the Board an opportunity to make recommendations with respect to such appointment. The Director shall receive basic pay at the rate provided for level II of the Executive Schedule under section 5313 of title 5, United States Code, and shall serve for a term of six years.

(b) Except as otherwise specifically provided in this Act, the Director shall exercise all of the authority granted to the Foundation by this Act.

(c) The Director may make such provisions as he deems appropriate to authorize the performance by any other officer, agency, or employee of the Foundation of any of his functions under this Act.

(d) The Director shall formulate the programs and budgets of the Foundation.

SEC. 9. DEPUTY DIRECTOR AND ASSISTANT DIRECTOR.

(a) There shall be a Deputy Director of the Foundation who shall be appointed by the President, by and with the advice and consent of the Senate. Before any person is appointed as Deputy Director, the President shall afford the Board an opportunity to make recommendations with respect to such appointment. The Deputy Director shall receive basic pay at the rate provided for level III of the Executive Schedule under section 5314 of title 5, United States Code, and shall perform such duties and exercise such powers as the Director may prescribe. The Deputy Director shall act for, and exercise the powers of, the Director during the absence or disability of the Director or in event of a vacancy in the Office of Director.

(b) There shall be nine Assistant Directors of the Foundation, who shall be appointed by the President, by and with the advice and consent of the Senate. Before any person is appointed as an Assistant Director, the President shall afford the Board and the Director an opportunity to make recommendations with respect to such appointment. Each Assistant Director shall receive basic pay at the rate provided for level IV of the Executive Schedule under section 5315 of title 5, United States Code, shall perform such duties and exercise such powers as the Director may prescribe, and shall have responsibility for one of the following:

(1) The National Information Office and the National Technical Information service.

(2) The Office of Policy, Analysis, and Assessment.

(3) The Office of National Programs.

(4) The Office of the Professions.

(5) The Office of Institutional and Human Resource Development.

(6) The Office of Small Business.

(7) The Office of Intergovernmental Technology and Professions Delivery Systems.

(8) The National Bureau of Standards.

(9) The Patent and Trademark Office.

(c) The Assistant Director for the National Bureau of Standards shall be the Director of the National Bureau of Standards.

SEC. 10. COUNCILS.

(a) Councils covering the full range of Foundation responsibilities shall be appointed by the Director, with advice from the Assistant Directors, to serve as independent public advisory bodies to the Director and the individual offices of the Foundation.

(b) Council members are to represent a wide cross section of United States society, including experts in the matters considered by the respective offices to be advised and including general consumers and representatives of labor, industry, business, academia, mass media, the public and private sectors, the professions, environmentalists, finance, and science.

(c) The Councils, in response to requests from the President, the Congress, or Directors or to questions raised on their own initiative, shall investigate, deliberate in public forums, and provide suitable recommendations on the directions of the long-term and basic policies addressed by the Foundation and its officers, compatible with the interests of the public.

(d) The Councils, drawing upon the area expertise, comprehensive policy data, policy analysis and assessment, and alternative policy evaluations of the Foundation offices, shall provide institutional forums to examine, debate, and make recommendations upon the coherence, consistency, and compatibility of national policies with respect to—

(1) each other and the national interest;

(2) their contribution to rational integrated national policy and the national vision; and

(3) issues crucial to the development of coordinated, mutually supportive national policies.

(e) The Councils, serving as very visible public forums for current, midterm, and future national policies, shall offer an institutional means for seeking a broad national consensus in support of these policies.

(f) Each Council shall include such committees as shall be found necessary to satisfy the purview of the Council, including committees for sectors of the economy, industry, and national life quality.

(g) The appropriate Councils shall assess private sector requests for Government assistance or relief and recommend as a condition of such assistance or relief—

(1) those actions of the private sector which will ensure that the applicant involved, by receiving the assistance or relief, will become internationally competitive in the future; and

(2) any adjustment commitments which should be entered into by relevant parties, such as management and employees of the applicant, shareholders, creditors, suppliers and dealers, and financial institutions to ensure that the applicant will become internationally competitive in the future.

(h) The Council for Policy, Analysis, and Assessment shall produce a biannual review of national needs, problems, and opportunities with an analysis of the progress made to satisfy these needs and opportunities, including an assessment of the performance of existing public and private institutions. Particular attention shall be paid to the interdependence of national policies and their compatibility with each other and the long-term national welfare and trade competitiveness.

SEC. 11. GENERAL AUTHORITY OF THE FOUNDATION.

(a) The Foundation shall have the authority, within the limits of available appropriations, to do all things necessary to carry out the provisions of this Act, including but not limited to the authority—

(1) to hold such hearings, sit and act at such times and places, take such testimony, and receive such evidence as the Board (or a Council appointed by the Director) considers appropriate for the purpose of carrying out this Act;

(2) to establish additional offices and other organizational structures within the Foundation;

(3) to prescribe such rules and regulations as it deems necessary governing the manner of its operations and its organization and personnel;

(4) to make such expenditures as may be necessary for administering the provisions of this Act;

(5) to enter into grants, contracts, cooperative agreements, or other arrangements with whatever persons, organizations, countries, or other entities are

deemed most useful by the Foundation to accomplish the purposes of this Act;

(6) to acquire, hold, or sell real and personal property of all kinds necessary to carry out the purposes of this Act;

(7) to receive and use funds and property donated by others, if such funds and property may be used in furtherance of the purposes of this Act;

(8) to accept and utilize the services of voluntary and uncompensated personnel and to provide transportation and subsistence as provided by section 5703 of title 5, United States Code, for persons serving without compensation;

(9) to arrange with and reimburse other Federal agencies for any activity which the Foundation is authorized to conduct;

(10) to receive funds from other Federal agencies for any activity which the Foundation or the other agencies are authorized to conduct; and

(11) to appoint and fix the compensation of personnel necessary to carry out the provisions of this Act.

(b) Except as provided otherwise in this Act, appointments under subsection (a)(11) shall be made and the compensation of the appointed personnel shall be fixed in accordance with the provisions of chapter 51 and subchapter III of chapter 53 of title 5, United States Code, except that the Director may, in accordance with such policies as the Board shall prescribe, employ technical and professional personnel and fix their compensation, without regard to such provisions, to the extent deemed necessary to carry out the purposes of this Act.

SEC. 12. COORDINATION OF PROGRAMS.

(a) The Director shall insure that all programs of the Foundation are coordinated with other programs of the Federal Government, with the private sector, and with State and local government programs.

(b)(1) A standing National Foundation Coordinating Board, comprised of five members from the Board of the Foundation and five members from the Board of each of the other two national foundations (the National Science Foundation and the National Foundation on the Arts and Humanities), shall be appointed and shall meet at least twice a year to provide recommendations to improve the collective effectiveness of the three foundations in the national interest.

(2) To the greatest extent feasible, extramural basic research fields which the Foundation wishes to advance shall be supported through the National Science Foundation programs by transfer of funds to the Science Foundation.

(3) The Foundation shall coordinate studies in societal value systems and ethics with the applied humanities programs of the National Foundation of the Arts and Humanities.

(c) The Foundation shall coordinate its small business activities fully with those of the Small Business Administration and shall not conduct any small business program which the Administrator of the Small Business Administration finds to be duplicative of that Administration's programs.

(d) The Foundation is authorized and directed to provide assistance to the Office of Science and Technology Policy upon request.

SEC. 13. SCHOLARSHIPS AND GRADUATE FELLOWSHIPS.

(a) The Foundation may award scholarships and graduate scholarships for the study of the public professions.

(b) Any scholarship or graduate fellowship awarded under subsection (a) shall—

(1) be for use at any educational institution selected by the individual receiving such scholarship or graduate fellowship;

(2) be made only to a citizen of the United States; and

(3) be made on the basis of ability.

SEC. 14. REPORTS.

(a) The Foundation shall transmit a report to the President for submission to Congress not later than one year after the Board has been duly organized and each odd-numbered year thereafter. Each such report shall contain—

(1) a detailed statement of the activities of the Foundation;

(2) the important national policy issues, emerging problems, and opportunities;

(3) a review and renewal of the vision of the Nation's life quality and competitive economy for the next decade; and

(4) the legislation or other action deemed appropriate to realize such priorities.

(b) In addition to the reports required by subsection (a), the Foundation shall make any study or report ordered by either House of the Congress, by any committee of either House, or by any joint committee of the Congress.

(c) At the request of either House of the Congress, of any committee of either House, or of any joint committee of the Congress, the Director shall furnish such House or committee with such assistance or information as it may request.

SEC. 15. MISCELLANEOUS PROVISIONS.

(a) The Director may exercise any authority available by law to the Secretary of Commerce with respect to any entity transferred by section 5(c), and the actions of the Director in exercising such authority shall have the same force and effect as when exercised by such Secretary.

(b) At any time more than one year after the date of the enactment of this Act, the Director, with the approval of the Board, may allocate or reallocate functions among the organizational components of the Foundation and may establish, consolidate, alter, or discontinue such components as may be necessary or appropriate.

(c) The Director may establish, alter, discontinue, or maintain such regional or other field offices as the Director may find necessary or appropriate to perform the functions of the Foundation.

(d) The Director may, when authorized in an appropriation Act for any fiscal year, transfer funds from one appropriation to another within the Foundation, except that no appropriation for any fiscal year shall be either increased or decreased pursuant to this subsection by more than 5 percent and no such transfer shall result in increasing any such appropriation above the amount authorized to be appropriated therefor.

(e) Chapter 53 of title 5, United States Code, is amended—

(1) by adding at the end of section 5313 the following new item:

"Director, National Policy and Technology Foundation.";

(2) by adding at the end of section 5314 the following new item:

"Deputy Director, National Policy and Technology Foundation."; and

(3) by adding at the end of section 5315 the following new item:

"Assistant Directors, National Policy and Technology Foundation (9).".

(f) Section 10 of the Stevenson-Wydler Technology Innovation Act of 1980 is repealed.

SEC. 16. AUTHORIZATION OF APPROPRIATIONS.

There is hereby authorized to be appropriated to the Foundation for the fiscal year 1987, the sums indicated for the following categories:

(1) National Information Office and National Technical Information Service, $5,000,000.

(2) Office of National Policy, Analysis, and Assessment, $20,000,000.

(3) Office of National Programs, $30,000,000.

(4) Office of the Professions, $140,000,000.

(5) Office of Institutional and Human Resource Development, $100,000,000.

(6) Office of Small Business, $40,000,000.

(7) Office of Intergovernmental Technology and Professions Delivery Systems, $40,000,000.

(8) National Bureau of Standards, ($150,000,000).

(9) Patent and Trademark Office of the Department of Commerce, ($120,000,000).

(10) National Design Reliability and Quality Council, $10,000,000.

(11) Other purposes of this Act, $9,000,000.

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STATEMENT OF

Allen B. Rosenstein

Chairman of the Board
Pioneer Magnetics, Inc.
Pioneer Research, Inc.
Santa Monica, CA

Professor of Engineering
University of California
at Los Angeles

on

The National Policy and Technology Foundation Act

before the

Subcommittee on Science, Research and Technology
of the Committee on Science and Technology

United States House of Representatives

Washington, D.C.

April 29, 1987

STATEMENT ON

The National Policy and Technology Foundation Act

Allen B. Rosenstein

April 29, 1987

Mr. Chairman and Members of the Committee:

I am pleased and privileged to testify in support of the National Policy and Technology Foundation Act of 1986. The legislation which you are proposing provides the machinery needed to address and resolve some of the most critical problems facing our nation.

The importance of this legislation has been described most succinctly by Mr. Pat Choate, Director of Policy Analysis, TRW Inc. Mr. Choate could not testify in person, for the National Policy and Technology Foundation Act, but he has written:

> "The message that is being sent to the Congress and the President by distinguished leaders from business, government, unions and academia is that government must give much more attention to how it forges economic policy and how these policies affect the competitiveness of our nation's economy. The legislation you are considering is an important step in that process. It provides high level oversight and the mechanisms that are required to collect and analyze information, secure a broad open consideration of views and translate analyses into specific policy recommendations for the President and Congress.
>
> Whether the coordination mechanism is located in the White House or an agency is important, but secondary to the fact that such a mechanism is required, and desperately. What is important is that your legislation would elevate the issue of trade and competitiveness to a parity with foreign policy and national defense. That has long been needed.
>
> Equally important, your proposal would begin the long overdue process of improving the coherence of federal decision making, particularly as it influences the competitiveness of the U.S. industries. That too has long been needed.
>
> In sum, the legislation you propose is central to any larger national effort to improve America's economic competitiveness."

Introduction

History will rank the four decade decline in U.S. trade competitiveness and relative life quality among the most severe traumas the Republic has ever experienced. Certainly the experience will be found to be unique for its complexity and far reaching consequences. The U.S. loss of trade and economic leadership cannot be described or understood in conventional terms or with simplistic models. The extent and complexity of the competitiveness/life quality issue must cause the nation to reexamine and ultimately change many of its most cherished and time proven concepts, institutions, structures and policies.

The trade competitiveness/life quality problem is fundamentally institutional and structural. The country's institutional structure is flawed and unsuited for the dynamics of modern society - lacking means to create and facilitate the integrated public-private policies so necessary to the country's long term interest. Unlike other trade competitors, the U.S. Congress simply does not have the tools to cope with the far reaching complexity of modern international society. Without means to anticipate crises before they become critical, opportunities before they are lost, develop an adequate data base, formulate and assess policy alternatives and in particular, generate the national consensus necessary for public acceptance of proposed policies, the nation will continue to dissipate its considerable resources and stagger from one avoidable crisis to another.

There should be little doubt that the quality of life we leave for our children will hinge upon our ability to rebuild the nation's competitiveness. Yet the complexity and magnitude of the competitiveness problem is so great that the problem cannot be addressed much less resolved until the underlying causes are thoroughly understood.

It is human nature to blame one's own failures upon the actions of others. When the loss of trade competitiveness and the decline in relative U.S. life quality could no longer be ignored or denied, we have found comfort in believing that the successful trading nations were not playing by the rules. It is true that market restrictions and unfair practices by our trading partners have contributed to our trade problem. However, all other effects pale in comparison to the damage we have done to ourselves. By most estimates, unfair trade practices are responsible for only 10 to 15 percent of our trade deficit. The remaining 85 to 90 percent of the loss has been self inflicted.

Slowly but surely and largely unnoticed, American industry has become disadvantaged with respect to its trade competitors for essentially every important determinant of trade competitiveness. From short sighted national policies affecting capital availability, interest rates, work force education and adversarial regulatory practice to obsolete methods for developing and deploying civilian technology, the disincentives to retaining a U. S. manufacturing presence far outweigh the incentives.

The magnitude of the competitiveness issue and its causes can be illustrated by the following outline:

CAUSES FOR U.S. DECLINE IN COMPETITIVENESS/LIFE QUALITY

I. Obsolescence of the National Policy Making Process

II. Disadvantagement of U.S. Industry: U.S. Industry is disadvantaged with respect to its international competitors for every important determinant of trade competitiveness including:

  A. U.S. Means for Developing and Deploying Technology are Outmoded and Uncompetitive

  B. U.S. National Policy is Unsupportive, Counterproductive and Often Self Defeating

OBSOLESCENCE OF THE NATIONAL POLICY MAKING PROCESS

In the early days of our Democracy, the speed of communication and the rate of change of the technology were both leisurely. The Town Hall meeting provided an adequate forum to debate issues. The people could explore alternatives and develop a consensus upon an equitable distribution of the gains and sacrifices inevitably associated with any public policy.

Growth in population and mass communications along with rapid change in technology and trade competitiveness have rendered the Town Hall Policy making process obsolete. In its place are many very large and vocal special interest groups with well defined, legitimate self interests that are often in sharp conflict.

Under the Constitution, Congress has the responsibility for creation and oversight of national policy in the public welfare. However, Congress cannot discharge this responsibility with its present resources. Lacking an accepted public forum for most issues, Congress has little means to reconcile conflict among the very real interests of large groups of constituents.

It is unreasonable to expect Members of Congress to consistently take positions that will automatically alienate a majority of the voters. Yet this is the situation that exists today for critical issues such as acid rain which has waited resolution for eight years, the trade deficit, the budget deficit and not too long ago the Social Security crises. When faced with complex, legitimate and conflicting demands, our national institutions are too often inadequate, consequently, the political process fails.

The President's Commission on Industrial Competitiveness (Young Commission) found:

> "The competitiveness issues facing American today are not new yet they remain unresolved. The ability of the political decision making process to deal with them is impeded by conflict among the very sectors needed to solve the problems we face. Policy makers must deal with widely disparate points of view presented by a diversity of interested parties. Often there is not agreement as to the facts of the issue much less a shared understanding of the tradeoffs in the policy options under discussion."

U.S. INDUSTRY DISADVANTAGED

A major consequence of the structural deficiencies of American national policy institutions has been a continuous slow, but steady disadvantagement of U.S. industry. Lacking supportive coherent national policy and struggling with inefficient means for developing and deploying advanced technology, industrial advantage has gone abroad and trade deficits have come home.

TECHNOLOGY-DEVELOPMENT AND DEPLOYMENT

In comparison with our trade partners, U.S. institutional, structural, policy and strategic means for the development and deployment of needed commercial technology are outmoded, inefficient cumbersome, uncompetitive and in too many instances non existent. To illustrate the problem, let us consider:

1. The Japanese Experience
2. Current U.S. Position
3. Process for Failure - Sematech

The Japanese Experience

After WWII, the 100 year old U.S. agriculture system which brings industry, government, university and national laboratories together in cooperative technology development and deployment programs served as a model for the rest of the world. Japan early recognized the dominant role of technology in the realization of national policy and adapted the U.S. agricultural system to all industry with stunning success. Technology development and deployment became a major component of Japanese national policy.

The Ministry of International Trade and Industry (MITI) has long served as Japan's principal national policy facilitating instrument. A world wide system for gathering and translating information makes data on a broad spectrum of subjects readily available to Japan's public and private decision makers. Policy offices within MITI constantly review the data for potential national problems and for industrial and business opportunities.

MITI explores, evaluates and assesses policy alternatives with standing national councils. The councils, independent and outside of MITI, are made up of prominent representatives from all sectors and segments of Japanese society. By publicly debating and reviewing policy alternatives and the best strategies for their implementation, the councils serve as forums generating the public consensus necessary for legislative action.

Essentially all important aspects of the U.S. agriculture system have been adapted and refined for Japanese industry including sixteen national institutions and laboratories in MITI's Agency of Industrial Science and Technology. Particular consideration has been given to the development and deployment of industrial technology for all industry. MITI offices and programs range from assistance to small and medium industry to national projects requiring extensive industry, government, university and national laboratory cooperation. Few opportunities are ignored. Attention is given to the development of fundamental technology as well as more urgent and feasible technology.

In 1982 we visited Japan to obtain a first hand knowledge of the Japanese Policy mechanism. A report was written which is appended.[1] Of special interest (and some concern) is the speed with which national policy is translated into cooperative programs. The role of government is to act as a convener, facilitator and frequently partner to industry. The success of the Japanese strategy hinges upon free and voluntary industry participation. The government seldom provides the bulk of the funding or the personnel.

Some understanding of the efficiency, effectivity and timeliness of the Japanese strategy for developing and deploying critical technology can be obtained by briefly examining the history of some important Japanese technology initiatives. Two projects from the 1970's are often described as prototypes.[2]

The most obvious prototype was called the "Fourth Generation Computer Project." At a time when U.S. firms completely dominated the world's semiconductor market, Japan invested in the cooperative Fourth Generation Computer Project to develop the manufacturing technology for the next generation of large scale integrated circuits (VLSI). The VLSI program ran for 4 years (1976 to 1980). Five companies participated in the project along with MITI's Electrotechnical Laboratory. The initial budget was $300 million with MITI contributing only 40% (Estimates of the final cost have gone as high as $1.2 billion.) Growing Japanese domination of the world chip market attests to the success of Japan's cooperative technology strategy.

The Fifth Generation Computer Systems project followed on the heels of the Fourth Generation. On September 9, 1981 the Information Industry Committee of MITI's Industrial Structure Council issued a report recommending, " Research and Development of a Fifth Generation Computer." Seven months later on April 14, 1982 a non-profit organization called the Institute for New Generation Computer Technology, ICOT, was established.[1] ICOT's budget last year was $36 million.[2] The initial technical staff consisted of forty experts from industry, government and industry. Present sponsorship comes from the Electrotechnical Laboratory, Nippon Telephone and Telegraph Laboratory and seven corporations.

Cooperative programs are encouraged in a wide range of promising industrial fields such as optoelectronics, which are beginning to play a major role in telecommunications and computing. The Japanese are building a complete optoelectronics industry at the system level.[3] This industry, which did not exist in 1980 is projected to reach $60-70 billion by the year 2000. In 1979 the initial optoelectronics project was budgeted for $75 million and seven years. Fourteen industrial organizations and MITI's Electrotechnical Laboratory formed a cooperative joint venture that included an advanced optoelectronics laboratory. The Japanese consider the Optoelectronics Applied System Project to be highly successful. Professor Merz observes: "as in the case with the VLSI project, it appears that Japan will go from a position behind the United States to virtual domination of the optoelectronics device market during a time span only a little longer than the lifetime of their cooperative project." A second, follow-on project with a 10 year life, thirteen cooperating companies and a $60 million budget will be established in 1987.[3]

Success of the cooperative industry-government projects has lead to the creation of the Japan Key Technology Center (JKTC). The Center provides modest seed money for not over 70% of project cost to two or more companies that jointly establish an R&D company or consortium.[6]

In addition to its highly publicized successes in electronics and computers, Japan is applying its technology development and deployment strategy to essentially every promising industrial area. Business Week in its April 13, 1987 issue reported on "Designer Proteins: The Next Boom in Biotech."[5] Here again MITI has put together a consortium of fourteen companies in a $113 million, cooperative ten year program to dominate commercialization of bio-engineered proteins. In predicting future market share for bio-engineered products, it is important to realize that fermentation is the production process used to mass produce these products. Japan's Fermentation Research Institute was established years ago as one of MITI's sixteen national industrial laboratories dedicated to advancing the nation's technology and industry.

Industrial success accrues not to the leader in basic research but to the nation that is the first to bring a mass produced, cost-effective, quality product to the market place. Trade competitiveness and market domination require the ability to economically and rapidly develop and deploy civilian technology. In the early 1980's Japan required seven months to establish the Fifth Generation Computer Systems Project. On February 15, 1987 the University of Houston announced a breakthrough in superconductors. Within four days, MITI announced its intent to bring together a consortium of Japanese companies, universities and government laboratories. Seven days later the consortium was in place with a rumored budget of $300 million.

> "Japan's stated objective" is to organize industry to get the jump on the West in applications and commercialization for a huge new market."[4]

When we compare Japan's well-established comprehensive institutions, policies and strategies for trade competitiveness with America's current position, the extent of U.S. industry's disadvantagement begins to take shape. The picture becomes even grimmer when we examine the trials and tribulations of the yet unborn Sematech project and realize that Japanese industry and government were able to come together in the cooperative superconductor project in just seven days. We must presume they rested on the eighth day - or perhaps they set out to seek new industries to dominate.

The U. S. Position

The United States does not have the coherent policies, institutions, or strategies which would enable American industry to develop and deploy advanced industrial technology economically or rapidly enough to compete in world trade. The bleakness of the American competitiveness position and the disadvantagement of U.S. industry is illustrated by four recent articles. (The full articles are appended.)

Peter Behr, Washington Post September 11, 1986, Does Kodak Have Any Home-Run Hitters: [7] Although Kodak is a $10 billion a year leader in photography, Kodak has decided not to challenge the Japanese in the commercialization of the electronic camera. Colby H. Chandler, Kodak chairman said, "American companies can't afford to fund the revolutionary process," Jacob Goldman, former chief technical officer of Xerox observes,

> "Kodak's cautious approach is unavoidable. Japanese consumer electronics firms enjoy an advantage over American rivals in their ability to pour money into projects like the video cassette recorder and the electronic camera where the payoff may lie more than a decade away. It's an R & D commitment that only the Japanese can make because of the whole financial structure of their industry. You're dealing with Japan, Inc. - they can afford to take those long term gambles."

Colby Chandler believes that companies such as Kodak must have technological advantages. Chandler said,

> "To compete American companies will have to find ways to share and pool technology. We desperately need in this country the ability for all of the collective strengths of American industry to be able to work together."

Los Angeles Times, March 17, 1987, It Takes Giants to Battle Japan in Chip Market: [8] Recognizes that even U.S. companies with revenues of $600 million to $1 billion per year do not have the financial resources to keep up with the technology and compete with cooperative Japanese programs which pool scarce intellectual resources as well as sharing the financial risk.

Business Week, April 6, 1987, The U.S. Has The Advances, But Japan May Have The Advantage: [9] Uses the superconductor development to question whether the U.S. may have to consider imitating Japan (which originally followed the example of U.S. agriculture).

Robert Kuttner, Business Week, August 1986, "U.S. Farm Policy Is A Cornucopia Of Mistakes": 10 Robert Kuttner describes the disastrous consequences of incoherent U.S. farm policy. For over 100 years, U.S. Agriculture has had a partnership of industry, government, national laboratories and university, which has allowed less than 2% of the working population to produce over 120% of the nation's food and fiber requirements. U.S. industry with few exceptions has not enjoyed the benefits of cooperative technological development available to U. S. Agriculture. At the same time, however, American industry has long suffered from the policy incoherence that is now devastating agriculture.

Kuttner's article is important for it shows that efficient institutions for technology development and deployment are a necessary but not sufficient condition for trade competitiveness. In spite of the unquestioned technological competence of the U.S. agricultural industry, incompatible U. S. monetary policy allowed Argentine wheat to be delivered last year in Minneapolis at a price lower than that of wheat grown in Minnesota. Trade competitiveness requires both effective technology deployment and the creation of coherent national policy to provide an environment that supports and nurtures industry vital to our economic growth and life quality.

Sematech - A Process Comparison

The current perilous position of the U.S. semiconductor industry and the attendant discussion of the Sematech proposal highlights how outmoded, uncompetitive and inefficient American means for developing and deploying commercial technology have become in comparison to that of our trade competitors. It is not that Sematech is not important. Sematech is vital to the survival of a critical industry. Unfortunately, there is no existing U.S. institution available to breath life into a Sematech on a time table that would allow the U.S. to remain competitive. (Three recent articles are reviewed and appended.)

The Congress should realize that the prize Japan seeks is not the chip industry, but the much larger computer industry. Beginning with the takeover of consumer electronics in the 1950's, Japan has successfully applied the same strategy to industry after industry. Excess capacity is built to supply basic materials and components. Predatory pricing drives out U.S. material and component suppliers. Once dominance is achieved in materials and components, the emphasis is shifted to subassemblies and this process repeated until the entire industry falls.

Electronic Engineering Times, March 16, 1987: White House Group To Weigh Sematech Alternatives: 11 The financial and intellectual resources needed to develop the production techniques and equipment for the next generation of integrated circuits are beyond the resources available to the individual chip manufacturers.

The industry has come together to seek a cooperative venture called, Sematech, with government participation. After the customary and probably prolonged debate and review the proposal will go to the Congress for possible funding. Since there are no suitable U.S. civilian agencies or national laboratories for the development of manufacturing technology, the Congress must turn, as it has in the past, to the Department of Defense (D.O.D.).

Involving the D.O.D. will in turn require a justification of the program in the name of national defense and thus requires a military overlay. After all other hurdles are cleared, a special anti trust dispensation will be necessary to allow competing companies to come together.

The speed of this process, directed to maintaining a competitive position in a rapidly changing high technology commercial field, is glacial compared to that exhibited by our competitors in opto-electronics, the fifth generation computer, superconductors, bioengineered proteins, etc.

Los Angeles Times, March 29, 1987, Military:[12] This article questions the effectivity of the Pentagon as the patron of a civilian high-tech program. The article reviews the progress of the VHSIC (Very High Speed Integrated Circuit Program) that was begun several years ago with a budget of $300 Million to be the U.S. answer to the original Japanese LSIC chip program. D.O.D.'s VHSIC program is now substantially behind schedule and is projected to cost nearly $1 Billion by 1990, triple its original estimate. The chips developed to date offer very limited commercial applicability.

As the only government agency that could address needed commercial technology - albeit in the name of defense, the D.O.D. has served the country well in the past. However, the times have changed. It is now apparent that the D.O.D. technology conduit is too expensive, time consuming and burdened with too many military requirements to effectively supply commercial technology no matter how badly needed.

Los Angeles Times, April 10, 1987: Chip Maker Suppliers Are Urged to Unite:[13] Stanford Kane, IBM vice president, points out that the 800 U.S. companies that supply U.S. chip makers are in even more dire financial straits than the semiconductor chip manufacturers. If the equipment makers die off, U. S. Chip makers will be dependent on foreign suppliers for the machines that permit creation of state-of-the art chips. IBM supports Sematech as a non profit organization of U.S. chip makers that would seek to match the Japanese through cooperation upon the development of advanced manufacturing processes and equipment.

U.S. NATIONAL POLICY - UNSUPPORTIVE, COUNTERPRODUCTIVE AND OFTEN SELF DEFEATING

Modern trade competitiveness requires not only efficient, effective means for developing and deploying technology, but also the full spectrum of integrated, coherent, mutually supportive national policies needed to create the environments necessary for healthy competitive industry. The list of counter productive and/or conflicting national policies often appears endless. Eight important policy examples follow.

o Interest Policy and Competitiveness

In recent years interest rates been manipulated to combat inflation. At present they are beginning to be driven by the need to finance the budget deficit. The myopic application of monetary policy without regard to the effect upon trade competitiveness has taken a terrible toll.

Interest on loans is a legitimate cost of doing business. However, Japanese and German industrial interest rates are less than half that of the U.S. The U.S. corporation is therefore forced to devote a much larger portion of its income to debt service. Conversely, the American company obtains much less capital for a given interest payment. Higher interest rates must also result in higher selling prices to provide an industrial investment return that is competitive with the return available on other investments.

o Uncompetitive Capital Formation and Availability

Coherent national policy must be designed to ensure adequate financing for U.S. industry regardless of size.

Practically every modern nation has restructured tax and financial policies to address the problems of adequate financial support for competition in international trade. The U.S. has put together a patchwork approach that is not working too well. Our national saving rate is barely 1/4 of Japan's. In some respects our financial structures are medieval.

The time has come to undertake a comprehensive financial structure analysis with attention to the synthesis and assessment of more competitive alternatives. Much attention has been paid to venture capital for innovative small companies, but inadequate attention has been given to the financial requirements of international competition. There is a need to rethink the entire industrial financing process.

Traditional equity financing does not allow U.S. industry to compete effectively with debt financed competitors. A U.S. corporation requires an equity to debt ratio of 2 or 3 to 1, while Japanese corporations operate with a debt to equity ratio of 2 or 3 or more to 1. This gives the Japanese corporation a financing advantage of up to nine times that of a U.S. company.

To illustrate the above point, consider two corporations, United States and Japanese, that begin business at the same time with equal capital and equal profitability. Assume both companies earn $1,000,000 after taxes, at the end of the first year. The U.S. company could then borrow perhaps an additional $400,000. The Japanese corporation could borrow up to $3,000,000 and at a much lower interest rate. We must assume industrial dominance depends in large measure upon capital availability. It thus becomes obvious that the annual compounding of the above capital growth rate will insure that the U.S. company will be a fraction of the size of its Japanese competitor at the end of 5 years when they meet in international competition. The preceding scenario is not hypothetical. It is being replayed every year for highly successful high technology companies such as National Semiconductor and Intel. Their very success leaves them starved for capital when they reach a sales volume of $500 million to $1 billion a year. (See ref. 8, It Takes Giants to Battle Japan in Chip Market)

The claim is not being made that equity financing must be abandoned for debt financing. However, the entire tax, savings and industrial financing structure should be reexamined in light of our present national needs and the existing international environment.

- Incompatible and Uncompetitive Tax Policies

  Much has been written about U.S. conflicting and incoherent tax policies. A few tax policies with competitiveness consequences are worth reviewing.

  Many of our trade competitors such as Germany, have a value added tax that is remitted to exporters. It is true that a value added tax is regressive, but it is also true that the nearly 15% of selling price that the German exporter receives from his government provides a significant market price advantage.

  With the competitive ability of U.S. equity financing under question, U.S. tax policies do not encourage saving or participation in equity financing. Investment ultimately depends upon savings, whether personal, pension or corporate, which in turn, are a direct function of many other policies including tax policy. The Japanese save at a rate over three times that of their American counterparts. This is not a national trait, for U.S. and Japanese savings rates were nearly identical in 1930. The Japanese save because it is rational to put money in savings when Japanese tax policy allows a family of three to receive tax free interest on savings up to nearly $200,000.

- Uncompetitive Monetary Policies

  Driven by the spector of inflation in the early 1980's, the U.S. embraced monetary policies that appreciated the U.S. dollar and made U.S. manufacturing uncompetitive in world markets. (The U.S. dollar went from four French Francs to ten Francs causing a 250% price increase for U.S. goods in France.) Unable to compete in their American factories, a massive off shore migration of U.S. manufacturers was triggered. It is unlikely that these factories will return in the near future.

While the recent devaluation of the dollar has given some measure of relief, many of our trading partners have pegged their currency to the dollar. When the dollar drop is measured against a weighted average (by trade volume) of the currency of our trading partners, the devaluation of the dollar has a long way to go before the exchange rate returns to previous levels.

o Adversarial Regulatory Policy and Practice

The inefficiency of American regulatory policy and practice in meeting environmental needs wastes valuable industrial resources and further reduces competitiveness. In contrast to U.S. adversarial regulatory practices - exacerbated by anti trust - the more efficient trading nations resolve important environmental needs on a cooperative basis with industry, government and university joining to seek an effective resolution.

o Educational Policy

America's commitment to an educated population has faltered at the time when trade competitiveness requires the most highly educated and skilled work force in the nation's history. With 20% functional illiteracy and general mathematics and science capabilities hardly better than that of third world nations, America is not prepared to hold its own in the high technology markets. Japan also turns out over 50% more engineers than the U.S. Most of the Japanese engineers go into manufacturing.

See Reference 14: Simon Ramo, L.A. Times March 15, 1987,
Why We're Behind in Technology.

o Anti Trust

U.S.anti trust laws were created many years ago to provide a level business playing field for an internal economy with little foreign competition. Anti trust was proper in its day, but conditions have changed. The rules that were quite effective for local competition are now counterproductive. Today's corporations seek cooperative means to spread costs and efficiently develop common technology needed to face foreign competition. Cooperation is often delayed or stopped by the threat of anti trust action.

U. S. Antitrust Laws should be modified to conform to the realities of international competition. General Douglas McArthur ensured the incorporation of U. S. antitrust laws into post W.W.I.I. Japanese law. Japan, however, has made the modifications to its antitrust rules necessary to accommodate the realities of world market competition while maintaining rules for internal trade.

o Inefficient R & D Policy - R & D vs. D & R

The English-speaking nations place a high priority upon basic research. There is the fond expectation that the knowledge gained will trickle down through technological innovation, to industrial competence and finally reach the bottom line of trade competitiveness. This policy has given Britain, Canada and the U.S. the lowest post W.W.I.I. productivity improvement rates by far, of all of the industrial nations. Japan, on the other hand, has concentrated on securing and implementing the world's finest technology. Japanese productivity improvement is generally more than twice that of the U.S.

Our trade competitors do largely D. and R. They have known for many years that concentration upon commercial objectives pursuing only that basic research necessary to achieve a desired goal, is many times more efficient and timely than R. & D. After all, basic research is an international free good, available to everyone for the price of the journals.

THE NATIONAL POLICY AND TECHNOLOGY FOUNDATION

A trading nation that aspires to an acceptable quality of life will require a high level of efficiency/productivity from all segments of the society that contribute to the nation's trade capability. This capability must include that of the nation's infrastructure and the delivery systems for education, information, transportation, justice, waste materials, etc. that are the responsibility of local and state government. The answer to the loss of national competitiveness can only lie in competitiveness improvement. There are no quick fixes or easy cures. It took forty years to dig the economic hole we now occupy. It will take years of working together to regain our economic and trade leadership.

The National Policy and Technology Foundation Act will put in place the mechanisms long needed to correct the institutional and structural deficiencies that prevent a successful resolution of the growing competitiveness crisis. Means will exist to reverse the disadvantages and disincentives hobbling U.S. industry. Coherent national policy looking to create an environment conducive to industrial growth will be sought. Institutions will exist to anticipate and facilitate the cooperative development and deployment of the advanced technology needed to maintain international trade competitiveness. Future Sematechs will not go begging for a hospitable home while our trading partners move to dominate markets that were ours for the taking. (A Congressional Record description of the structure and functions of the Foundation is appended.)

Study of our more successful trading competitors would indicate that they have in place well established institutions to provide coherent national policy in the interest of trade competitiveness and efficient means to develop and deploy the technology required to support these policies. Four basic institutional elements working together seem to be necessary for success in the international market. These are:

1. Information Base:

   Means to collect, organize, maintain and efficiently disseminate a current comprehensive international and domestic data base.

2. Policy, Analysis and Assessment:

   Means to analyze and assess national problems, opportunities and policy alternatives including the impact of foreign initiatives and domestic policies upon the nation's competitiveness.

3. Public Consensus:

   Means to facilitate public debate and consensus generation to provide policy review and recommendations for the President and Congress.

4. Technology, Development and Deployment

   Means to facilitate development, transfer and deployment of civilian technology needed to advance the competitiveness of U.S. industry.

There are now a number of bills before the Congress addressing one or more of each of the above elements. As a result, at least three basic questions face you. First, can the nation effectively resolve the critical issues, including trade competitiveness by bypassing or eliminating any of the four previous elements? Second, is the probability of success enhanced by bringing the four elements together into a single working entity or is it better to continue with the functions distributed through the Government? Third, what type of organization or organizations are most likely to succeed in the American environment.

The four parts are consistent with major recommendations of the President's Commission on Industrial Competitiveness (Young Commission). The proposed legislation, which you are considering, recommends the inclusion of all four functions into a single national Foundation. There are undoubtedly many ways to house these basic elements. However, the overriding requirement for a successful structure must be its ability to bring all elements of our society together.

To conclude, I can only agree with Pat Choate when he says, "In sum the legislation you propose is central to any larger national effort to improve America's economic competitiveness."

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*12. L.A. Times, March 29, 1987, Military.

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*14. L.A. Times, March 15, 1987, Simon Ramo, Why We're Behind in Technology.

* Congressional Record.

* Appended

Resume

Allen B. Rosenstein

Industry:	Founder and Board Chairman: Pioneer Magnetics, Inc. Pioneer Research, Inc. Pioneer International Founder: INET, Inc. International Transformer Anadex Instruments
University:	Professor of Engineering - 1946 to date University of California at Los Angeles
Education:	B.S. in E.E. University of Arizona - 1940 - Magna Cum Laude M.S. University of California at Los Angeles - 1950 Ph.D. University of California at Los Angeles - 1958
Honors:	Fellow - Institute of Electrical and Electronic Engineers Tau Beta Phi - Engineering Phi Kappa Phi - Academic Delta Pi Sigma - Mathematics Sigma Xi - Science Who's Who in America; Engineering; Industry and Finance
Patents:	Five Patents on Electromagnetic Systems
Consulting:	U.S. Congress: Technological Innovation, Reindustrialization, Industrial Competition Industry - Engineering Systems and Electromagnetic Converters UNESCO - Planning for Higher Education U.S. and Latin American Universities - Educational Policy and Design for Professions Schools N.S.F. - Educational Systems
Books:	A Study of a Profession and Professional Education. Ford Foundation, 1968. Engineering Communication. Prentice Hall, 1964.
Publications:	Over 65 papers on - Societal Systems and National Policy International Competitiveness and Reindustrialization Engineering Design Circuit Theory Electromagnetic Converters Long Range Planning for Higher Education Engineering Education Curriculum Analysis, Design and Synthesis
Residence:	314 S. Rockingham Drive, Los Angeles, California 90049
Telephone:	Residence - (213) 476-1087; (213) 394-4824

FACILITATING NATIONAL POLICY

JAPANESE POLICY MECHANISM
POLICY CREATION AND IMPLEMENTATION

ALLEN B. ROSENSTEIN
July 9, 1982

FACILITATING NATIONAL POLICY

Contents:

I. Policy Mechanism

II. Policy, Creation and Structure

III. Policy Implementation

  a) Agency for Industrial Service and Technology

  b) Appended Examples

    1. Encouragement of Private Technology Development Efforts - Takeda Riken

    2. National Project - Fifth Generation Computer System

    3. National Project - Flexible Manufacturing System Complex.

General:

MITI's role in facilitating national policy is shown through specific examples of:

1. The Policy Mechanism
2. Policy, Creation and Structure
3. Policy Implementation

which are intended to illustrate the policy process. Time and space limitations preclude a complete and comprehensive description or analysis. As example, AIST is only one vehicle for policy implementation. The appended examples are also not exhaustive, but are offered to illustrate the translation of policy statements into program action. Equally important, only three elements of a larger Policy Mechanism have been given to illustrate major segments of the policy making mechanism.

I. POLICY MECHANISM

INDUSTRIAL POLICY BUREAU:

Structure: Nine Divisions
1) General Affairs
2) Industrial Structure *
3) Industrial Finance
4) Business Behavior
etc.

Five Offices
1) Industrial Organization Policy (Anti-trust)
2) Leisure Development
etc.

Responsibility: Overall coordination of industrial policies.

* INDUSTRIAL STRUCTURE DIVISION - Director: T. Tanabe

Responsibility:
1) The study of what Japan's future industrial structure should be.
2) Formulation of programs for implementing this ideal structure and coordination of policies when they are implemented.
3) Surveys and analyzes new industries (e.g. knowledge-intensive ones)
4) To design well coordinated industrial structure policies, materials are gathered on a wide range of industries through the Industrial Structure Council, an important deliberative organ of MITI handled by the division.

INDUSTRIAL STRUCTURE COUNCIL (20 Committees)

Responsibility: On its own initiative or in response to requests of the Minister of MITI, Council investigates and deliberates on the direction of long term and basic policies concerning Japan's industrial structure. Council produces a vision of the country's industrial structure every year in the form of a plan which is revised according to the pattern of a rolling plan.

Outputs: For MITI guidance

1. The Industrial Structure in Japan - 1963
2. The Vision of MITI's policies in the 1970's
3. The Vision of MITI's policies in the 1980's
4. The Industrial Structure of Japan in the 1980's
5. Highlights of MITI's Policy for 1981.

I. Policy Mechanism

On the facing page, three of the major elements of a national policy creating mechanism are listed.

MITI's Industrial Policy Bureau has the responsibility for overall coordination of industrial policies.

The Industrial Structure Division of the Industrial Policy Bureau is expected to study the structure (composition and nature) of Japan's future industries.

The Industrial Structure Council composed of outside experts and community representatives is the premier policy council of Japan and advises MITI on long term and basic policies concerning Japan's industrial structure. A major output of the Council is a ten year large picture policy report (Vision of MITI's Policies in the Late 1980's) which is revised annually. Committees of the Industrial Structure Council and other councils provide supporting policies consistent with the nation's objectives that in turn lead to projects and programs for implementation.

II. POLICY, CREATION AND STRUCTURE

I. THE VISION OF MITI POLICIES IN THE 1980's NR-226, March 17, 1980
By: The Industrial Structure Council

Provides the overall framework for MITI policies for the 1980's and establishes three new national goals:

1) Contributing to the international community
2) Overcoming the limitations of natural resources and energy
3) Improved quality and comfort of life

II. THE INDUSTRIAL STRUCTURE OF JAPAN IN THE 1980's - FUTURE OUTLOOK AND TASKS
By: The Industrial Structure Council BI-44, May 1981

This report, following the lines recommended by the Policy Vision, presents the future outlook of the industrial structure of Japan in the 1980's and the tasks that must be faced.

III. HIGHLIGHTS OF THE MITI's POLICIES FOR 1981 - NR-263, October 12, 19
-Aimed at Building a Foundation for Sustained Economic Growth-
By: The Industrial Structure Council

The annual report which, based upon I and II,provides the programs and projects implemented under the Policies during the current year (1981).

IV. RECOMMENDATION AND DATA - June 15, 1981
To Guide Japan Toward the 21st Century by Promoting Informatisation
By: Information Industry Committee of the Industrial Structure Council

The Vision in the 1980's advances as one of its policies the promotion of "knowledge Intensive Technologies". This report outlines the "Information Field" discussing problems and offering data and recommendations.

V. REPORT OF THE INFORMATION INDUSTRY COMMITTEE ON "INFORMATISATION"
NR-262, Sept. 9, 198

Outlines the direction for "informatisation" and the information industries in the 1980's. Emphasizes the need to establish an information oriented society and identifies the role of the computer information processing industry in promoting a knowledge intensive industrial structure in the 1980's. Problems, policies and implementation measures are offered.

II. Policy, Creation and Structure

Five steps in the progressive creation of national policy and a coherent, consistent policy framework are illustrated on the facing page. (Page 2-4) Beginning with "The Vision of MITI Policies in the 1980's", the Industrial Structure Council after public debate and review produced a framework of national policies for the 1980's and established three new national goals. These policy statements formed the background for the succeeding report that provides the guidelines for the Industrial Structure of Japan in the 1980's indicating the industries and programs that could expect support during the decade.

To avoid the dangers of static policies in a changing society, the Industrial Structure Council reviews MITI's policies every year. The dates on which the first three reports were published would indicate the progressive development of policy.

If a nation decided to overcome "the limitations of natural resources and energy," the development of its information processing resources and industry is the logical conclusion reached by the Industrial Structure Council. Consequently, the Council has an Information Industry Committee which produced two reports in 1981 that built upon the information policies advanced by the Council. The first carefully explored the "Information Field" discussing problems and opportunities, projections for the future and a set of recommendations. The second report appearing only three months later offered specific recommendations and programs whose implementation appeared within a year.

III. Policy Implementation

Japan has a number of vehicles for the implementation of national policy. The Agency of Industrial Science and Technology, AIST, with many laboratories, institutions and an annual budget of approximately $700,000,000 is a major contributor. For large scale projects involving universityand industry, AIST will often act as the lead agency. In other cases an independent, not for profit corporation with a limited life will be created.

In this section we briefly examine the structure, responsibilities, project categories and typical programs of AIST. It is important to realize that each AIST program is a direct and logical consequence of publicly debated and published national policy. This consistency of policy enables the various societal sectors- public, private, academic - to join cooperative programs extending over lengthy time periods with full confidence in the program continuity and probably success.

Three specific examples of Policy Implementation are offered. The first is an illustration of the effectivity of a policy to encourage technology development in the private sector. A second outlines a major national project operated by a special not for profit corporation and the third is a large national project coordinated by AIST. In each case we have sought the particular policy statement which lead to the project.

III. Policy Implementation, Cont.

III a. Agency of Industrial Science and Technology of MITI.

Vehicle: Agency of Industrial Science and Technology of MITI

Established: 1948

Personnel: 4005 (1981)

Budget: Approx. $700,000,000. (1982)

Responsibilities:

1. Planning, dissemination and implementation of comprehensive policies related to MITI's administration of Technology.
2. Implementation of various experimental and research programs in response to social and administrative need.
3. Includes:
    a) Development of natural resources.
    b) Modernization of production methods.
    c) Upgrading of production technology
    d) Standardization of Industry
    e) Encourage and subsidize R&D in Japan's private sector.
    f) Comprehensive system of research and experimentation to realize above policies. (MITI H.B.77- p.115 AIST 1981- p.8)

Organization:

a) General Coordination Department (includes direction and administration)
    1. National R&D programs.
    2. R&D of Basic Technology for Future Industries
    3. Energy Technology Planning
    4. Technology Promotion - Private industry, medical & welfare technology.
    5. Prevention of Industrial Pollution
    6. Technology assessment & Planning of Long Range Industrial R&D Strategy.

b) Standards Department

c) Sixteen Institutions and Laboratories
    1. National Metrology Lab
    2. Geological Survey
    3. Mechanical, Electrotechnical, Chemical Labs.
    4. Fermentation Research Institute
    5. Industrial Products Research Lab.
    6. Polymers and Textiles
    7. Pollution and Resources
    8. Seven Regional Government Industrial Laboratories.

III a.: CONT.

Project Categories:

I. Ordinary R&D: for development of fundamental technology

II. Special R&D: for more urgent and feasible technology

III. National Projects:* R&D based on coordinated industrial and academic efforts.

Programs:

1.* R&D projects on Basic Technologies for New Industries.

2.* The Sunshine Project - R&D on New Energy Technology (1981 Budget-$130,000,000.)

3.* The Moonlight Project - R&D on Energy Conservation Technology

4.* National R&D Programs - Large Scale Projects.

Examples: a) High speed computer systems
  b) Flexible Manufacturing System Complex (Total expend. $50 million.)
  c) Unmanned Tailoring System- Seven years - $60,000,000.

5.* Medical and Welfare Equipment Technology R&D - 1981 Budget - $3,500,000.

6. Promotion of Private Sector Technological Development
  a) Subsidies for important R&D projects.
  b) Investment (at low interest rate) via Development Bank.
  c) Research Association System - cooperative research assoc.
  d) Technology Promotion Tax system.

7. Promotion of Industrial Standardization.

8. Technology Assessment.

III b. Examples of Policy Implementation

Three specific examples of policy implementation are given:

1. Encouragement of Private Technology Development Efforts - Takida Piken.
2. National Project - Fifth Generation Computer System.
3. National Project - Flexible Manufacturing Systems Complex.

III b (1). Policy Implementation - Encouragement of Private Technology Development Efforts.

Example: Takeda Riken

Policy: Highlights of the MITI's policy for 1981.

Industrial Structure Council (Oct.12, 1981, NR-263)

Section 4. Promotion of Technology Development.

Recommendation 4 - Encouragement of Private Technology Development Efforts (P.13).

> "To encourage technology development by private business enterprises, the subsidy system will be effectively utilized in such a way as to stimulate the development of critical technology."

Results: The consequence of long term industry-government cooperation can be seen in the attached material describing Takeda Riken.

2- 10.

Takeda Riken is a classical example of the ability of long-range Industrial Policy to produce in this case a world class manufacturer of electronic test equipment.

A. HISTORY

The story of Takeda Riken is given in the following pages.

1. In 1954 Takeda Riken Industry was founded with an initial capitalization of 500,000 Yen ($2,500).
2. By 1961, Takeda Riken received the first of a long series of two-year "Research Subsidies" by the Ministry of International Trade and Industry (MITI) to develop basic instrumentation and measurement elements.
3. In 1970 the Japan Society for the promotion of the Machine Industry gave the company a project for new machine development.
4. Four years later in 1974, Tadeda Riken joined with six other measuring equipment manufacturers for MITI's First Important Technology Development Program. This subsidy was renewed in 1970.
5. The Research Development Corporation of Japan gave orders in 1978 for the joint development of manufacturing technology for magnetic resonator elements.

B. RESULTS

Two decades of extensive industry government cooperation in support of national policies is summed up in the May 1, 1982 issue of ELECTRONIC BUSINESS, Page 62.

> "The appearance of .... Tadeda Riken among the top suppliers of semiconductor production equipment signals a trend of deep concern to the United States Suppliers".

Takeda Riken with 710 employees expected sales of $85,000,000 and profits of over $10,000,000 for fiscal 1980.

Allen Rosenstein, P.E.
Professor of Engineering
University of California
Los Angeles

July 9, 1982

2-11.

Premium performance equipment from Japan

The appearance of two Japanese companies, Takeda Riken and Canon Inc., among the top suppliers of semiconductor-production equipment signals a trend of deep concern to United States suppliers, which have been dominant up to now. Long content with buying U.S. equipment with which to make their chips, Japanese companies are increasingly turning to, and finding, domestic suppliers to meet their needs.

Unlike Japanese penetration of other electronics markets such as consumer and instrumentation, Japanese suppliers of production equipment for semiconductors aren't entering with low-end, low-technology products. Takeda Riken makes advanced VLSI component testers. Canon, which manufactures early-generation but still very useful proximity mask aligners, also makes state-of-the-art step and repeat (stepper) aligners as well. Canon "owns" the proximity market and competes with leaders Perkin-Elmer Corp. in projection aligners and GCA Corp. in steppers.

The Japanese pattern is repeating itself in one respect: Their home market provides a base from which to attack U.S. and other markets. "I think you'd be kidding yourself if you say they're not a threat," says Noel C. MacDonald, director of marketing for the semiconductor operations of Perkin-Elmer. "Look at the huge potential market in Japan alone," he says. "They've got to be setting themselves up [for penetration elsewhere]. They have all the incentives they need."

Canon's new projection aligner, competitive with Perkin-Elmer's, should do well in Japan and "pick up market share here," observes G. Dan Hutcheson, vice president of market-research firm VLSI Research Inc. Canon's machine has automatic alignment, "which means that National Semiconductor [which uses several] can have one operator run three aligners," he says. That reduces labor costs "phenomenally" while also increasing throughput, he adds.

As good as Canon is, it's Tokyo Electron Ltd. (TEL) that could become the No. 1 semiconductor-equipment supplier by the end of the decade if the present trend continues, according to VLSI Research. The company has been aggressively pursuing cross-licensing agreements with major U.S. suppliers that give it manufacturing rights in Japan. Agreements so far include Cobilt's wafer-prober and wafer-track systems, TRE's stepping aligner and Thermco's diffusion furnace. "They get the license to manufacture a piece of equipment in Japan and then improve on it," such as Cobilt's wafer prober, Hutcheson notes.

Moreover, TEL also is a sales representative for E.T. Systems' plasma etchers, Varian's ion implanters and Mech-El's wire bonders, Hutcheson says. Whereas TEL was only No. 15 in equipment sales in 1980, it could move up fast as part of a total business that includes complementary expertise in computer-controlled systems, measurement-analysis systems and electronic components, VLSI Research points out.

Tokyo Ohka Kogyo Co., already the world's No. 1 supplier of plasma etchers, is another one to watch, Hutcheson says. One of the reasons it makes good plasma etchers is that it's also a strong photoresist manufacturer and understands the materials side of the business.

Nihon Jido Siegyo, by offering fully automatic inspection equipment for masks and reticles, merits watching also. Automatic inspection is important because as many as 8 million one-micron places for defects could lie on a four-inch wafer, Hutcheson explains. An automatic inspector can catch up to five times more defects than an operator can.

Giant Hitachi Ltd. could be important in the equipment business, but it's not clear whether it will enter the market or build primarily for internal use, Hutcheson says. Nikon has applied its well-known expertise in optics to make one of the better steppers, he says.

Other Japanese competitors include Ando Electric in testing and Anelva in plasma etching and vacuum deposition.

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Takeda Riken is up to the challenge.

Takeda Riken Industry Co.,Ltd.

Company information

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- **Registered name**

Takeda Riken Industry Co., Ltd.
Head Office: 1-32-1, Asahi-cho, Nerima-ku,
Tokyo 176, Japan
Phone: Tokyo 930-4111
Cable Add.: TRITRONICS TOKYO Telex: 272-2140
Main Plant: 1-18-1, Fujimi-cho, Gyoda, Saitama 361, Japan
Phone: (0485) 54-8211 Telex: 2842528

- **Business category**

Manufacturing and selling of electronic measuring equipment and automatic test equipment.

- **Company registration**

December 18, 1946

- **Capital**

Yen 400,000,000.-

- **Main share holders**

Fujitsu Ltd.
Kaisematsu-Gosho Ltd.
Saitama Electronic Lab.
Tokyo Lease Co., Ltd.
Mr. Ikuo Takeda
The Nissan Fire & Marine Insurance Co., Ltd.
The Dai-Ichi Kangyo Bank Ltd.

- **Directors**

Risei Kaiwa	Representative Director & President
Kazusada Sogo	Representative Director and Executive Vice President
Noboru Man'ei	Executive Managing Director (General Manager of Engineering and Production Division)
Takamitsu Saigusa	Executive Director (General Manager of Corporate Planning Group)
Tadayuki Adachi	Executive Director (General Manager of Sales Division; General Manager of Sales Department)
Mitsuo Goto	Councelor
Kazuo Karasawa	Director (Deputy General Manager of Engineering and Production Division; General Manager of Production Control Department)
Haruo Aoki	Director (General Manager of Material Purchasing Department)
Tohru Kazamaki	Director (Corporate Strategic Staff for R&D)
Sadao Nakamura	Director (General Manager of Administration Division)
Susumu Takehara	Auditor

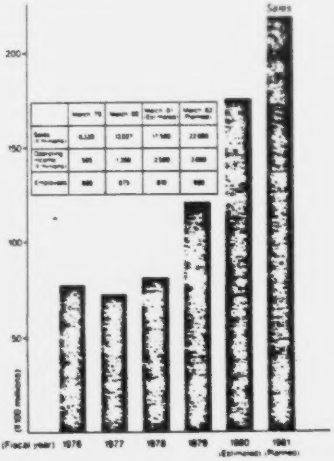
- **Employees**

940 as of April 1, 1981
(Male 840, Female 100)

- **Banks**

Dai-Ichi Kangyo Bank Ltd.
  Main Office
The Taiyo Kobe Bank Ltd.
  Kami-itabashi Branch, Tokyo
The Sanwa Bank Ltd.
  Ginza Branch, Tokyo
The Bank of Tokyo Ltd.
  Ikebukuro Branch, Tokyo
Japan Long Term Credit Bank Ltd.
  Main Office, Tokyo
The Yasuda Trust & Banking Co., Ltd.
  Ikebukuro Branch, Tokyo

- **6 Year Financial Review**



	March 79	March 80	March 81 (Estimated)	March 82 (Planned)
Sales (¥ millions)	[illegible]	[illegible]	[illegible]	22,000
Operating income (¥ millions)	[illegible]	[illegible]	[illegible]	[illegible]
Employees	[illegible]	[illegible]	[illegible]	[illegible]

Brief history in management

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1954
- Takeda Riken Industry Co., Ltd. was built in Tokyo. Capital 500 thousand yen. Started production of sensitive Electrometers.

1957
- Started production of Electronic Counters.

1959
- Main facility was newly built at Nerima-ku Tokyo.
- Entered quantity production of Digital Counters.

1960
- Opened a Sales/Service Office in Osaka.

1961
- Awarded 1961 Research Subsidy by the Ministry of International Trade & Industry (MITI).

1962
- ncreased Capital to 8 Million Yen.
- uilt an additional plant.

1963
- Honored as an excellent medium/small enterprise by Tokyo Metropolitan Office.
- Awarded 1963 Research Subsidy by MITI.
- Entered quantity production of Digital Voltmeters.
- Opened Sales/Service Office in Nagoya and Kyushu.

1964
- Honored by Tokyo Metropolitan Office for 100MHz direct reading Frequency Counter.
- Honored by Medium-Small-Enterprises Agency as an excellent enterprise.
- Increased Capital to 40 Million Yen.
- Awarded 1964 Research Subsidy by MITI.

1966
- Awarded 1966 Research Subsidy BY MITI.

1967
- Built a plant for measuring systems.
- Opened Sales/Service Office in Yokohama, Mito and Sendai.

1968
- Opened a Sales/Service Office in Nagano.
- Awarded 1968 Research Subsidy by MITI.

1969
- Awarded 1969 Research Subsidy by MITI.

1970
- Built a new facility in Gyoda for Engineering, Development nd Production.
- ceived a promotion project for new machine development rom the Japan Society for the promotion of Machine Industry.

1971
- Extended products line into Mini-computer controlled measuring systems.
- Started handling of Oscilloscopes and Pulse Generators under an arrangement with Philips.
- Awarded 1971 Research Subsidy by MITI.

1972
- Succeeded to develop first Japanese LSI Test System in cooperation with Japan Society for the Promotion of Machine Industry.
- Started distribution of Realtime Signal Analysis System under an agreement with Nicolet Scientific Corporation.
- Awarded 1972 Research Subsidy by MITI.

1973
- Awarded 1973 Research Subsidy by MITI.

1974
- Increased Capital to 138 Million Yen.
- Terminated the arrangement with Philips.
- Joined MITI's First Important Technology Development Program with 6 other measuring equipment makers.

1975
- Mr. Mitsuo Goto succeeded the president.
- Proceeded rationalization of management constitution under the recession.
- Increased Capital to 150 Million Yen.

1976
- Reorganized the management with capital participation by Fujitsu, Kanematsu-Gosho, Tokyo Lease, Nissan Fire & Marine Insurance, and Dai-ichi Kangyo Bank.
- Announced new models of LSI Test Systems.
- Awarded Second Important Technology Development Subsidy by MITI.

1977
- Mr. Risei Kaiwa was elected the president.
- Withdrawal from computer controlled Measuring Systems to improve the profitability.
- Terminated the agreement with Nicolet Scientific Corporation.
- Honored for cooperative research on a Josephson's Standard Equipment by Electro Technical Laboratory.
- Awarded for development result of LSI Test Systems by the Japan Society for the Promotion of Machine Industry.

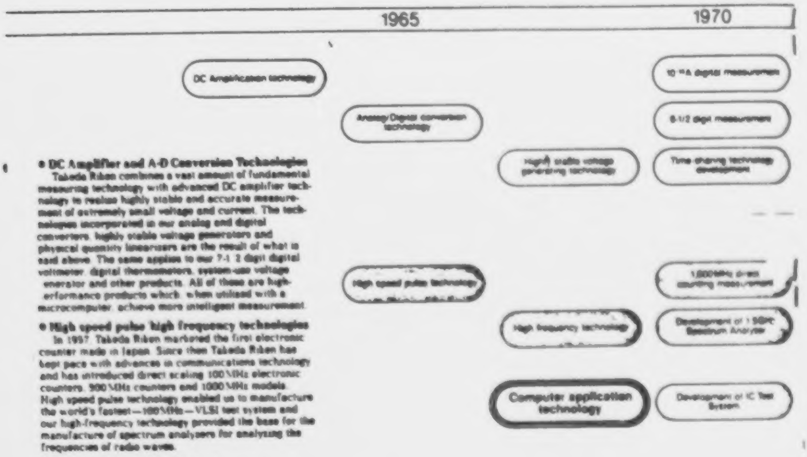
1978
- Ordered by Research Development Corporation of Japan to jointly development of manufacturing technology for magnetic resonator element using YIG (Yttrium Iron Garnet)" with Fuji Electrochemical Co., Ltd.

1979
- Increased capital to 250 million yen.
- Awarded 1979 subsidy by MITI (for 2 years).
- Built new plant at Gyoda facility.

1980
- Increased capital to 400 million yen.
- Opened a Sales/Service Office in Tsukuba.

The technological history of Takeda Riken

2-15



1965
1970
DC Amplification technology
Analog/Digital conversion technology
High speed pulse technology
Highly stable voltage generating technology
High frequency technology
Computer application technology
10⁻¹⁵A digital measurement
8-1/2 digit measurement
Time-sharing technology development
1,000MHz direct counting measurement
Development of 1.5GHz Spectrum Analyzer
Development of IC Test System

• DC Amplifier and A-D Conversion Technologies

Takeda Riken combines a vast amount of fundamental measuring technology with advanced DC amplifier technology to realize highly stable and accurate measurement of extremely small voltage and current. The techniques incorporated in our analog and digital converters, highly stable voltage generators and physical quantity linearizers are the result of what is said above. The same applies to our 7-1/2 digit digital voltmeter, digital thermometers, system-use voltage generator and other products. All of these are high-performance products which, when utilized with a microcomputer, achieve more intelligent measurement.

• High speed pulse high frequency technologies

In 1957, Takeda Riken marketed the first electronic counter made in Japan. Since then Takeda Riken has kept pace with advances in communications technology and has introduced direct scaling 100MHz electronic counters, 500MHz counters and 1000MHz models. High speed pulse technology enabled us to manufacture the world's fastest—100MHz—VLSI test system and our high-frequency technology provided the base for the manufacture of spectrum analyzers for analyzing the frequencies of radio waves.

• Applied Computer Technology

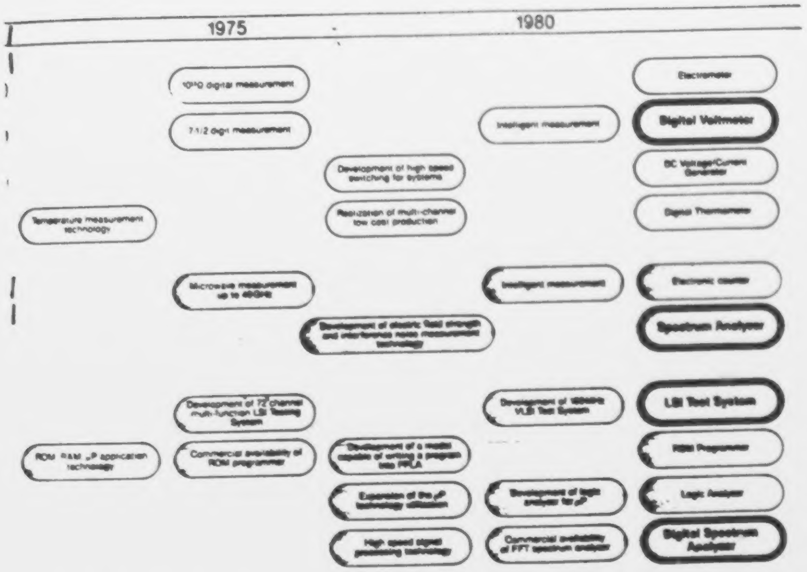
Applied computer technology has opened a new age to measuring instruments. This technology is used in a variety of commercial systems and is shared in LSI test systems and those with GP-IB. It also plays an important role in the intelligent measurement program of Takeda Riken. In conjunction with its software technology, including FFT algorithm, applied computer technology is now being incorporated in our digital spectrum analyzer as a first step toward enlarged intelligent measurement.

History in quality assurance

1964 • Equipped Japan's first private cesium beam frequency standard
1966 • Introduced the concept of traceability to the national standards.
Fully equipped the standard instruments including standard cells.
Started warranty of measurement results.
1968 • Completed the standard laboratory (room temperature stability: ±1°C)
• Organized the Quality Assurance Group to control the product's quality at user's side and also to review the MTBF on practical information in the field.
1969 • Started mobile laboratory service for calibration servicing to users throughout the country.
• Equipped the rubidium beam frequency standard at Tokyo and Osaka servicing stations to reinforce traceability.
• Embarked in hybrid technology.

1969 • Developed and manufactured high precision and high stability winding resistors (5ppm/°C, 10ppm/year)
• Established a warranty system for high reliability parts such as zener diodes and crystal oscillators.
• Built 6 month assurance system for the accuracy of digital voltmeter
1970 • Added a new standard laboratory (23°C ±0.3°C) following operation of Gyoda plant.
1971 • Equipped the IC tester developed by own company and started inspection of all incoming digital ICs
1972 • Succeeded to make the first Josephson voltage standard system and delivered it to Electro Technical Laboratory
1973 • Equipped the second cesium beam frequency standard
• Reinforced control system for resistance standard (1ppm level, high resistance up to $10^{14}\Omega$)

2-15 B


1975
1980
$10^{10}\Omega$ digital measurement
7 1/2 digit measurement
Development of high speed switching for systems
Realization of multi-channel low cost production
Temperature measurement technology
Intelligent measurement
Electrometer
Digital Voltmeter
DC Voltage/Current Generator
Digital Thermometer
Microwave measurement up to 40GHz
Development of electric field strength and interference noise measurement technology
Intelligent measurement
Electronic counter
Spectrum Analyzer
Development of 72 channel multi-function LSI Testing System
ROM RAM µP application technology
Commercial availability of ROM programmer
Development of a model capable of writing a program into PPLA
Expansion of the µP technology utilization
High speed signal processing technology
Development of 100MHz VLSI Test System
Development of logic analyzer for µP
Commercial availability of FFT spectrum analyzer
LSI Test System
ROM Programmer
Logic Analyzer
Digital Spectrum Analyzer

1974
- Established the temperature standard system
- Delivered the second Josephson voltage standard system to Electro Technical Laboratory

1975
- Established the high voltage calibration system (DC 30kV, 100ppm)
- Established the RF power standard system (2GHz to 8GHz)
- Located the parts handbook (TES-Takeda Riken Electronics Standard) at key places of the company for parts standardization to proceed high reliability designing, and inaugurated biweekly check system

1976
- Delivered the third Josephson voltage standard system to Electro Technical Laboratory (Japanese voltage standard maintained by the Josephson voltage standard as of January 1, 1977)

1977
- Introduced computer management system for internal traceability
- Developed 0.1ppm digital voltmeter ohmmeter to automate calibration and achieve higher precision

1978
- Further equipped defect analysis systems such as electron microscope, flouroscope, automatic cold impact tester and relay tester
- Introduced computer management system for technical design management

1979
- Established high precision warranty system for RF attenuator
- Introduced multilayer printed circuit boards and automatic design system
- Introduced design automation techniques
- Rebuilt the clean room for hybrid IC production

1980
- Fully equipped the standard laboratory (23°C ±1°C) at Osaka servicing station, and powered up calibration services in Western Japan

III b (2). Policy Implementation - National Project.

Example: Fifth Generation Computer Systems

Policy: Report of the Information Industry Committee of the Industrial Structure Council (September 9, 1981 - WR-262. P.25.)

Section 3. "Development of Guiding and Innovative Technologies."

Recommendation 2. "Research and Development of a Fifth Generation Computer."

Project Manager: Institute for New Generation Computer Technology. A non-profit organization established April 14, 1982, ICOT is supported by the government, academic institutions and computer manufacturers.

Outline of Plans: See attached.

Program: Ten years.

First step - 3 years: Development of basic computer technology.

Second step - 4 years: Development of subsidization.

Third step - 3 years: Development of total system.

Funding: $40,000,000 for first step.

Initial Organization: Forty experts from university, industry, government. Salaries paid by MITI for three years.

2-17

OUTLINE OF RESEARCH AND DEVELOPMENT PLANS FOR FIFTH GENERATION COMPUTER SYSTEMS

May 1982

ICOT

Institute for New Generation Computer Technology

2-18.

INSTITUTE FOR NEW GENERATION COMPUTER TECHNOLOGY

INTRODUCTION

Computers have become indispensable tools in our modern society. The computers are being used in more fields for more variety of applications and for more amount of information by more non-computer-professionals. However, the current computer technology has its own limit not to be able to meet these needs in the very near future. We will need new computer systems based on innovative theory and technology, which we name the Fifth Generation Computer Systems. The new computer systems will work as assistants to mankind with easy accessibility, high performance and advanced functions.

Under these circumstances we launched a new institute for research in the Fifth Generation Computer Systems. The Institute is a non-profit organization for research purpose, supported by the Government, academic institutions and computer manufactures.

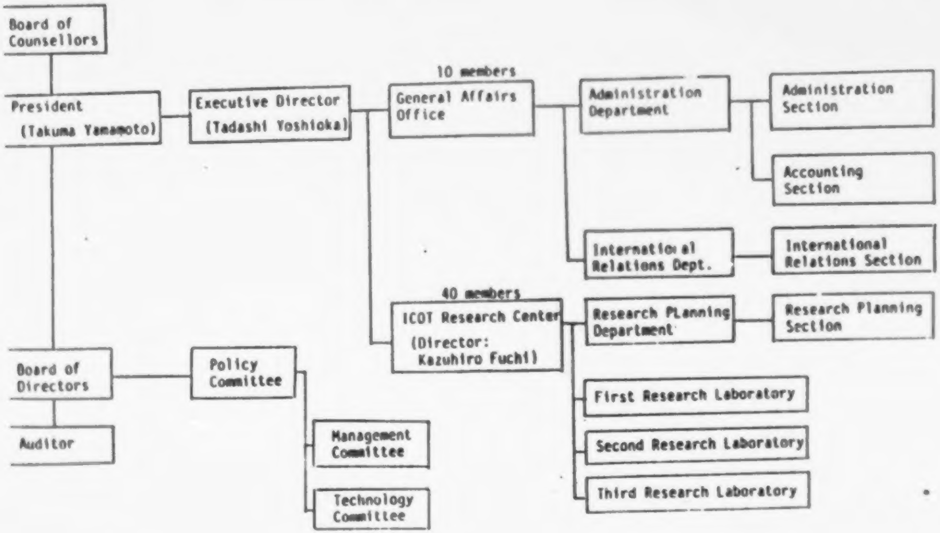
The new computer systems should contribute to the benefit of all mankind and our next generation. Therefore, we expect to promote international cooperation in the project, exchanging information and achievements to the mutual benefit of all involved in the world.

June, 1982

INSTITUTE FOR NEW GENERATION COMPUTER TECHNOLOGY

Establishment: April 14, 1982

ORGANIZATION


Board of Counsellors
President (Takuma Yamamoto)
Executive Director (Tadashi Yoshioka)
10 members
General Affairs Office
Administration Department
Administration Section
Accounting Section
International Relations Dept.
International Relations Section
40 members
ICOT Research Center (Director: Kazuhiro Fuchi)
Research Planning Department
Research Planning Section
First Research Laboratory
Second Research Laboratory
Third Research Laboratory
Board of Directors
Auditor
Policy Committee
Management Committee
Technology Committee

III b(3). Policy Implementation - National Project

Example: Flexible Manufacturing System Complex Provided with Laser.

Policy: The industrial Structure of Japan in the 1980's (Summary). - Future Outlook and Tasks - May 1981: BI-44, P. 45.

Based on materials furnished by the Industrial Structure Division, Industrial Policy Bureau, MITI.

"Processes. Areas of automation will expand through utilization of industrial robots, with greater flexibility to adapt the operations to the need for producing larger varieties of products in smaller quantities."

Object: To establish a complex manufacturing system that offers rapid and flexible production of machine components in small batches.

Project Manager: Agency of Industrial Science and Technology, MITI.

Duration: Seven years.

Budget: $50,000,000.

Participation:
- Three Government Laboratories
- Twenty Private Companies

Organization: Five technical subcommittees include four R&D groups organized to address critical technology problems. (See attached.)

RESEARCH ASSOCIATION 研究組合

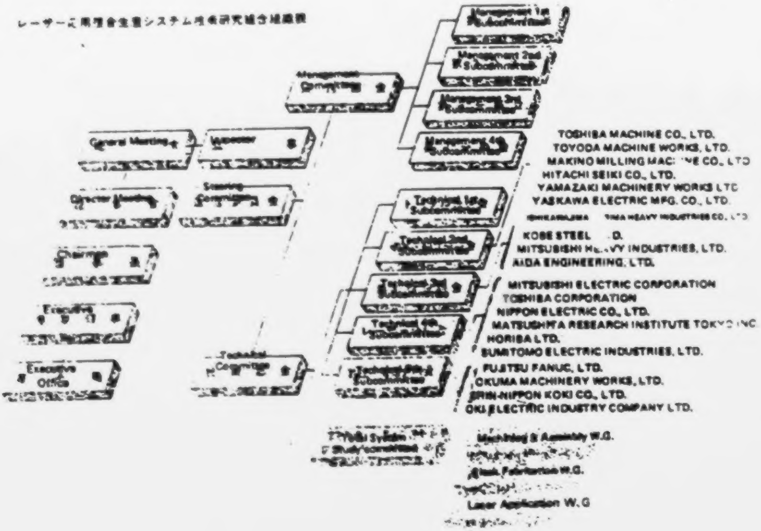
FMC

[illegible] それぞれポテンシャルの高い [illegible]

[illegible] その研究開発は [illegible] グループ [illegible] レーザー応用グループ [illegible]

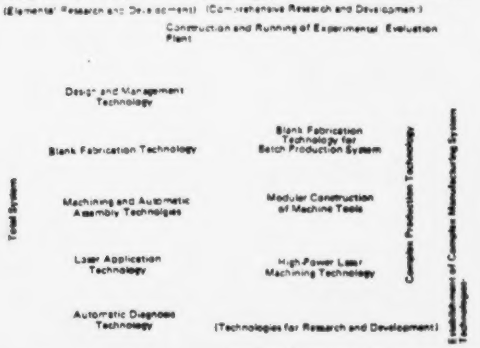
[illegible]

レーザー応用複合生産システム技術研究組合組織図


General Meeting
Inspector
Director Meeting
Steering Committee
Chairman
Executive
Executive Office
Management Committee
Management 1st Subcommittee
Management 2nd Subcommittee
Management 3rd Subcommittee
Management 4th Subcommittee
Technical Committee
Technical 1st Subcommittee
Technical 2nd Subcommittee
Technical 3rd Subcommittee
Technical 4th Subcommittee
Technical 5th Subcommittee
Total System Study committee
TOSHIBA MACHINE CO., LTD.
TOYODA MACHINE WORKS, LTD.
MAKINO MILLING MAC INE CO., LTD
HITACHI SEIKI CO., LTD.
YAMAZAKI MACHINERY WORKS LTD
YASKAWA ELECTRIC MFG. CO., LTD.
ISHIKAWAJIMA HARIMA HEAVY INDUSTRIES CO., LTD
KOBE STEEL D.
MITSUBISHI HEAVY INDUSTRIES, LTD.
AIDA ENGINEERING, LTD.
MITSUBISHI ELECTRIC CORPORATION
TOSHIBA CORPORATION
NIPPON ELECTRIC CO., LTD.
MATSUSHITA RESEARCH INSTITUTE TOKYO INC
HORIBA LTD.
SUMITOMO ELECTRIC INDUSTRIES, LTD.
FUJITSU FANUC, LTD.
OKUMA MACHINERY WORKS, LTD.
SHIN-NIPPON KOKI CO., LTD.
OKI ELECTRIC INDUSTRY COMPANY LTD.
Machining & Assembly W.G.
Sheet Fabrication W.G.
Laser Application W.G

Research and Development Program

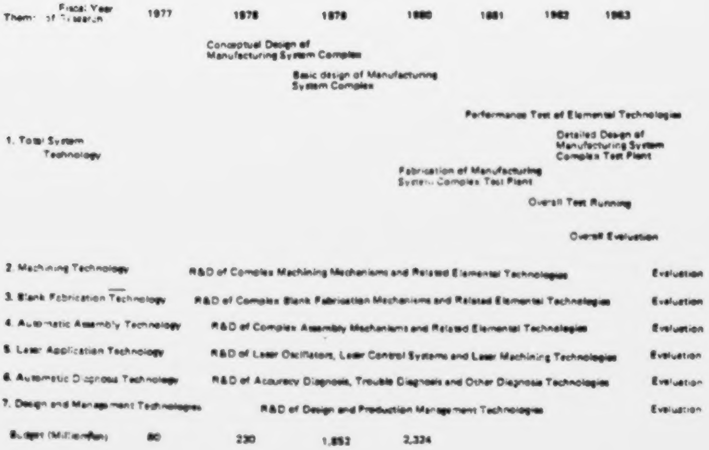
• R&D Flow Chart for Flexible Manufacturing System Complex Provided with Laser


(Elemental Research and Development)
(Comprehensive Research and Development)
Construction and Running of Experimental Evaluation Plant
Design and Management Technology
Blank Fabrication Technology
Total System
Machining and Automatic Assembly Technolgies
Laser Application Technology
Automatic Diagnoses Technology
Blank Fabrication Technology for Batch Production System
Modular Construction of Machine Tools
High-Power Laser Machining Technology
Complex Production Technology
Establishment of Complex Manufacturing System Technologies
(Technologies for Research and Development)

• Targets of R&D

Items	Targets
Products to be manufactured	Machine subassemblies which are max wt. 500 kg, max dimension 1000 mm and number of assembled parts max 200
Production time	Less than 50% of current value
Number of station for production	Less than 60% of current value
High-Power CO_2 gas Laser	Continuously stable output 20 KW, discharge tube life 2000 hr. and power efficiency min 15%
Medium-Power laser	Continuously stable Output 200W. Ar laser and 200W YAG laser

Long-Term Research and Development Program



ATTACHMENT #3

POLICY PLANNING INFORMATION SYSTEM

JAPAN'S POLICY PLANNING INFORMATION SYSTEM
and
Mechanisms for Information Collection, Organization, Processing, Dissemination and Utilization

Discussion

- Materials, energy and information are three of the most precious assets of any modern society.
- Early civilizations built upon their ability to process materials. Quantum advances were made as society learned to process energy in large amounts. The present day post industrial revolution is fueled by our rapidly increasing ability to process information.
- Japan recognizing the central role of information in societal decision and policy making has built an elaborate system to collect, process, disseminate and utilize information both from within and outside Japan.

A. External Information, i.e., foreign data.

Background: In the 1950's, the Japanese became concerned about blind trade, i.e., manufacturers operating without detailed information on what they should be producing for various foreign markets. In 1958, MITI established as a public corporation:

JAPAN EXTERNAL TRADE ORGANIZATION (JETRO)

1. Fundamental function - the dissemination of information.
2. Staffing:
   a) Key personnel including President and Executive Vice President from MITI.
   b) Virtually all of JETRO's overseas personnel are MITI transferees who return to MITI to continue their careers.
   c) As of March 1981 - 1233 employees (591 domestic and 641 overseas.)
3. Charter and organization - attached p.3-3.
4. Annual budget - $66,000,000 (1980).

B. Internal Information - domestic data

The Research and Statistics Department of the Secretariat is responsible for:

1. Compilation of Statistics: including the Census of Manufacturers
2. Analyses of Statistics.

C. The Policy Planning Information System Office of the MITI Secretariat has developed a computerized Policy Planning Information System - PPIS (see attached, p. 3-9)

1. Function - to provide abundant data and powerful software tools to support policy-making and decision-making in MITI.
2. Organization of PPIS
    a. DATA SOURCES
        1. Government Agencies
            a. MITI
            b. Ministry of Finance
            c. Economic Planning Agency
            d. Prime Minister's Office
            e. Ministry of Labor
            f. Administration Management Agencies
            g. Bank of Japan
            h. etc.
        2. Information Service Corporations
            a. JETRO
            b. IDE
            c. JAPATIC (patents)
        3. Industrial Groups
        4. International Organizations (U.N., etc.)
    b. DATA BASES
        1. Enterprises
        2. Technology
        3. International Trade
        4. International Economy
        5. Mineral Resources and Energy
        6. Industrial Activity and Market
        7. Macro-economic Inductors of Japan
        8. Pollution Control
    c. SOFTWARE
        1. Retrieval and Editing
        2. Tabulation
        3. Graph Display
        4. Analysis
        5. Model Building and Simulation
    d. USERS
        1. MITI (has 40 terminals)
        2. Agency of National Resource & Energy
        3. Patent Office
        4. Small and Medium Enterprise Agency
        5. Regional Bureaus of MITI (8)
        6. MITI Training Institute
        7. Ministry of Foreign Affairs

3-3

Japan External Trade Organization

JETRO

General Background

The Japan External Trade Organization – JETRO – was founded with Japanese Government capital in 1958 as non-profit organization for the promotion of trade. Prior to that, in the confusion of the post war years, a number of Governmental and private-sector organizations geared to export promotion had made their appearance.

Aware of the dislocated nature of the nation's trade activities, the Ministry of International Trade and Industry (MITI) realized the need for a new organization into which all Japan's international trade promotional functions could be incorporated. The Ministry proposed the establishment of such an integrated organization, and accordingly, legislation for the Japan External Trade Organization was presented and enacted at the 28th Ordinary Session of the Diet in 1958 (Law #95, April 26, 1958; Revised Law #169, July 11, 1958). The new organization was fully capitalized by the Japanese Government at ¥2,000 million and had a total operational budget of ¥1,812 million.

In 1958, the year JETRO was founded, Japan's total trade volume stood at US$6,000 million (exports US$2,876 million & imports US$ 3,033 million). Twenty-two years later, in 1980, this had reached a value of US$270,335 million (exports US$129,807 million & imports US$140,528 million). Over the same period, JETRO's capitalization increased to ¥10,200 million and the total annual operational budget rose to ¥15,500 million, with ¥9,550 million contributed by the Government.

Concurrent with this expansion of JETRO's operations was a significant change in the climate surrounding world trade, as represented by increasing interdependence among national economies and diversification of the structure of the world economy. In accordance with these changes, the role assigned to JETRO, which initially placed more emphasis on the promotion of exports from Japan, came to encompass more varied functions, including the promotion of mutual understanding among trading partners, import promotion – particularly manufactured goods, cooperative efforts to help develop overseas trade capability in developing countries, and liaison between small- and medium-scale industries in Japan and their overseas counterparts. These functions now constitute JETRO's fundamental role and are equally important as the organization's initial activity of export promotion.

Charter & Organization

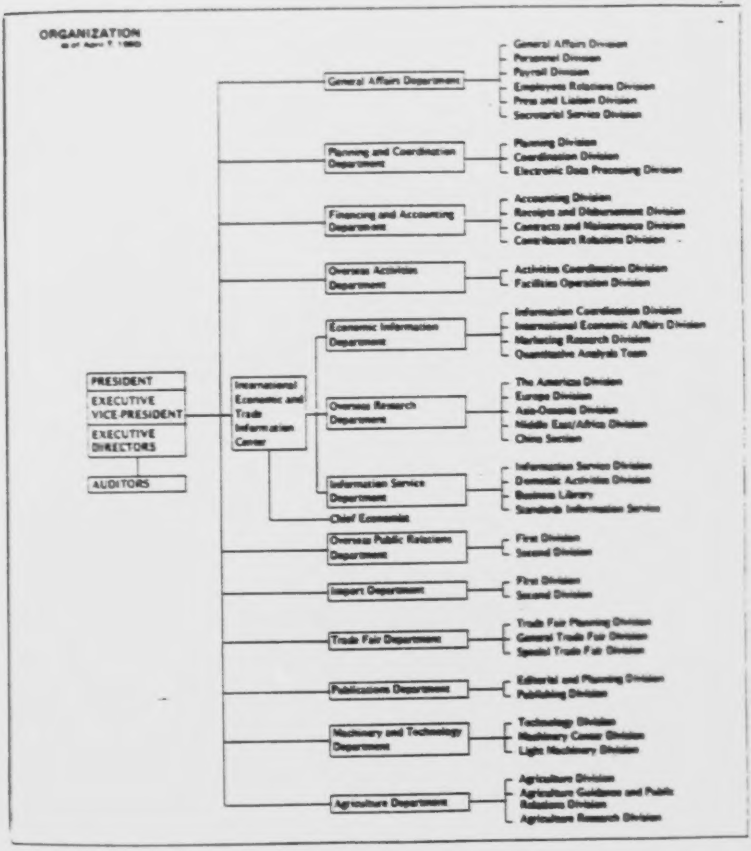
The organization and operation of the Japan External Trade Organization are set out and governed by specially enacted legislation. Activities authorized for JETRO by this legal framework can be summarized as follows:

1) Research into international trade and publication of research results;
2) Introduction and publicity of the industry and merchandise of Japan;
3) Services to facilitate international trade transactions;
4) Publication and distribution of printed materials on international trade;
5) Holding of, or participation in, exhibitions, trade fairs and similar events, and services to facilitate the holding of, or participation in, such events;
6) Activities to expand international trade commissioned by the Government, and;
7) All other affairs in connection with, or in addition to the aforementioned activities deemed necessary for the effective promotion of Japan's international trade.

In Japan, the organizational structure of JETRO Headquarters in Tokyo consists of 13 departments, incorporating 43 divisions. The Osaka Office and 29 local offices in other major cities serve as liaison units between Japan's local industries and overseas counterparts. JETRO local offices are at Sapporo, Aomori, Morioka, Sendai, Yamagata, Niigata, Nagano, Suwa, Yokohama, Shimizu, Nagoya, Tsu, Toyama, Kanazawa, Fukui, Kobe, Okayama, Hiroshima, Matsue, Shimonoseki, Takamatsu, Kochi, Tokushima, Fukuoka, Kitakyushu, Nagasaki, Kumamoto, Kagoshima and Naha.

All of JETRO's activities are supervised by the president, aided by an executive vice-president, and together with two auditors responsible for auditing all of JETRO's activities, are appointed by the Minister of International Trade and Industry. The president and vice-president are assisted by six executive directors.

As of March 1981, the breakdown of JETRO personnel was as follows: 1,232 employees, of whom 591 were engaged in domestic services, and 641, including 363 locally hired personnel, in overseas activities. Overseas, JETRO's network comprises 78 facilities located in the major cities of 59 countries. All these facilities are staffed by JETRO's regular representatives, and offer information and consultative services to both local and visiting Japanese businessmen.


ORGANIZATION
as of April 7, 1980

PRESIDENT
EXECUTIVE VICE-PRESIDENT
EXECUTIVE DIRECTORS
AUDITORS
General Affairs Department
General Affairs Division
Personnel Division
Payroll Division
Employees Relations Division
Press and Liaison Division
Secretarial Service Division
Planning and Coordination Department
Planning Division
Coordination Division
Electronic Data Processing Division
Financing and Accounting Department
Accounting Division
Receipts and Disbursement Division
Contracts and Maintenance Division
Contributors Relations Division
Overseas Activities Department
Activities Coordination Division
Facilities Operation Division
International Economic and Trade Information Center
Economic Information Department
Information Coordination Division
International Economic Affairs Division
Marketing Research Division
Quantitative Analysis Team
Overseas Research Department
The America Division
Europe Division
Asia-Oceania Division
Middle East/Africa Division
China Section
Information Service Department
Information Service Division
Domestic Activities Division
Business Library
Standards Information Service
Chief Economist
Overseas Public Relations Department
First Division
Second Division
Import Department
First Division
Second Division
Trade Fair Department
Trade Fair Planning Division
General Trade Fair Division
Special Trade Fair Division
Publications Department
Editorial and Planning Division
Publishing Division
Machinery and Technology Department
Technology Division
Machinery Center Division
Light Machinery Division
Agriculture Department
Agriculture Division
Agriculture Guidance and Public Relations Division
Agriculture Research Division

Information Dissemination

Services to Overseas Businessmen
JETRO's overseas facilities are equipped with the latest official statistics, including various trade indices, and other information on Japan's economy and trade. Based on these materials, JETRO's overseas facilities offer information and consultative services to local businessmen on various matters related to trade with Japan.
Information provided covers such subjects as standard procedures involved in export to and import from Japan, marketability of various products in Japan, Japanese commercial regulations and custom-trade practices & procedures, and introductions to Japanese exporters and importers. Further, JETRO liaises on various trade inquiries originating from overseas businessmen and business organizations (see "Trade Inquiry Services" on page 9).

Services to Japanese Businessmen
The daily flow of information coming into the Tokyo Headquarters in written reports, cables and telex messages and, in some cases, by telephone, in addition to printed materials by mail, is disseminated among Japanese businessmen throughout Japan through (1) JETRO periodicals and other publications; (2) over-the-counter services at all domestic facilities; (3) library services; (4) seminars; (5) the subscription members' system, '; (6) trade inquiry services.

Periodicals and other publications
Some primary media used in JETRO's information dissemination activities are a group of regularly published periodicals.
Tsusho Koho (Trade Bulletin)
A daily bulletin in Japanese carrying information immediately valuable to Japanese traders.
Kaigai Shijo (Overseas Market)
A monthly publication in Japanese. Contents include in-depth market reports, market analysis, special features, etc.
JETRO also publishes various other non-periodical Japanese and foreign language publications, including an "Annual Review on World Trade and Overseas Investment", based on information collected through its worldwide network (see "Publications" on page 14)

Over-the-Counter Services
In Japan, JETRO offers over-the-counter information services based on the information and data collected through its worldwide network. The services are conducted at the Tokyo Headquarters, Osaka Office and 29 other local offices located in major cities of the country. In these over-the-counter services, JETRO's experienced staff members answer questions on trade and investment and provide informational assistance.
In FY1980, approximately 26,600 individual service cases were processed by JETRO. The breakdown is as follows: 1) documentation and other procedural matters involved in export/import operations, 6,230 cases; 2) consultations on product marketability, 5,230 cases; 3) consultations on overseas investments, including joint ventures, 700 cases; 4) introduction of overseas exporters and importers, 12,600 cases; 5) introductions from inquiries by overseas exporters/importers received by JETRO, 1,450 cases, and; 6) translation services, 380 cases.

Library Services
JETRO maintains two libraries, one at the Tokyo Headquarters and the other at the Osaka Office. The libraries are the best public libraries in Japan specializing in trade and economic materials from various countries. All documents, which include government statistics, trade publications of both official and commercial natures, customs tariff schedules, company directories, annual reports and telephone directories for the major cities of the world, are constantly updated.

Breakdown of Materials at the Tokyo Library (as of June 1981):

Books	65,600
– Books in Japanese	19,600
Overseas Customs Tariff Schedules	134 countries
Overseas Trade Directories	4,500
Statistical Reports	
– Domestic	500
– Overseas	2,640
Overseas Newspapers	45
Periodicals	
– Japanese	220
– Foreign	382
Telephone Directories	284 cities in 80 countries

Seminars
Information dissemination efforts are also conducted through various seminars and briefing sessions held frequently by JETRO at a number of domestic locations for the benefit of local traders and businessmen.

Trade Inquiry Services

The one-way dissemination of information in the form of publications, library access, over-the-counter activities, and through seminars & sessions is, however, only a facet of JETRO's extensive information services. A large part of the organization's servicing efforts is spent attending to inquiries on trade and investment matters.

Overseas Inquiries
Approximately 300,000 inquiries from overseas individuals and organizations engaged in trade, business and other industrial and economic activities are handled annually by JETRO. The majority are handled locally by JETRO's overseas representatives. Inquiries that can be handled better by those in industry are either forwarded to the specific business organization or individual concerned or are publicly circulated in the *Tsusho Koho*, a daily bulletin. An average of 2,500 inquiries are circulated in this manner every year.

"Exporting to Japan"
For the purpose of assisting overseas exporters, JETRO publishes a directory, "Exporting to Japan." This lists the names and addresses of Japanese importers classified by the commodities in which they specialize or desire to handle.
The directory, which is up-dated annually, is available for reference at each JETRO overseas facility, as well as at local chambers of commerce and other trade-related organizations in various countries. Copy sale is also accepted. (For further information on sales of "Exporting to Japan", please contact the nearest JETRO facility or JETRO's Tokyo Headquarters.)

Information Collection

In order to support the organization's fundamental function — the dissemination of information, JETRO compiles and updates a vast amount of information on trade, economy and industry from various countries. This information collection is conducted through numerous research and survey projects and routine information gathering activities. In the main, information collection efforts are carried out by JETRO's staff members stationed abroad, and the bulk of information collected is obtained from various published sources — official reports, position papers, statistical data compilations, newspaper and magazine articles, directories and other publications. After collection, all information is concentrated at the Tokyo Headquarters, where items are processed to meet the specific objectives of the various service activities. Some basic data, such as trade statistics, are stored by computer. All publications, including major periodicals, are available to the public at the two JETRO libraries, one at the Headquarters and the other at the Osaka Office.

The major portion of information collected by JETRO constitutes fundamental data related to economy, industry and commerce that have a bearing on the promotion of trade between Japan and its trading partners. They include basic informataion on customs tariffs, business organizations, commodities, regulation changes and trade statistics.

Various marketing research projects designed to assess market potentiality for specific commodities for both export from, and import to, Japan are also an indispensable part of JETRO's information collection activities. In conducting this type of research, however, increasing emphasis is being placed on the discovery of new products, the export to Japan of which may eventually contribute to a redressing of the trade balance between Japan and its trading partners.

JETRO Subscription Members
For the purpose of facilitating ready and thorough access by both relevant individuals and organizations to the varying kinds of information collected by its extensive worldwide network, JETRO maintains a subscription members' system.

All commercial, industrial, financial or other organizations recognized under Japanese law and individual Japanese nationals are eligible to become JETRO subscription members on payment of an annual fee. Current membership constitutes more than 5,000 organizations. The breakdown by trade is as follows: industrial associations, export/import cooperatives — 7%; trading companies — 37%; manufacturing firms—47%, and; miscellaneous—9

3-9

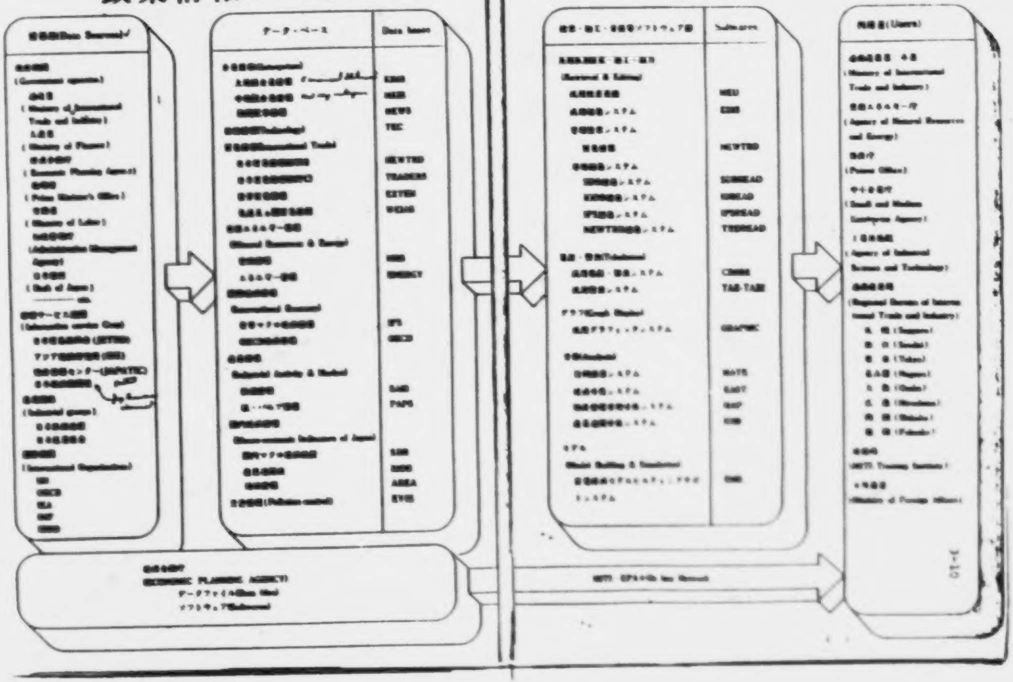
政策情報システム

PPIS

Policy Planning Information System

政策情報システム

Policy Planning Information System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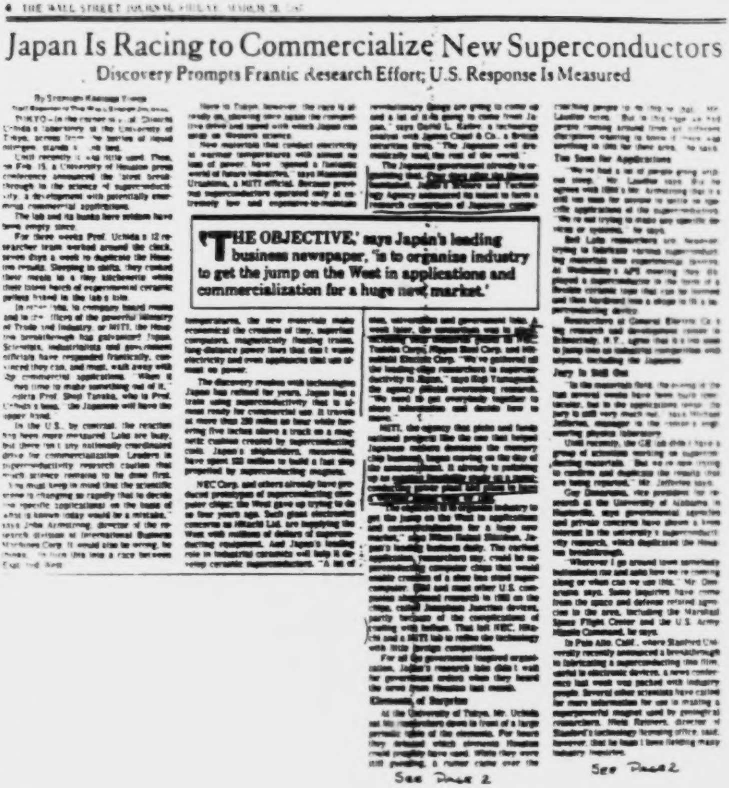

THE WALL STREET JOURNAL

Japan Is Racing to Commercialize New Superconductors

Discovery Prompts Frantic Research Effort; U.S. Response Is Measured

"THE OBJECTIVE,' says Japan's leading business newspaper, 'is to organize industry to get the jump on the West in applications and commercialization for a huge new market.'

Too Soon for Applications

Jury Is Still Out

Elements of Surprise

See Page 2

See Page 2

phone that the material was fluorine. Students ran out and bought fluorinated chemicals. For three days they tried out hundreds of combinations until they found the rumor was false.

Acting on another tip that the Houston material was dark green, the researchers mixed all the plausible chemicals that would become green when fired, again with no success. (The material needs to be fired further until it is black, they found later.) Then a news report said a Chinese lab had achieved superconductivity at 100 degrees Kelvin (minus 173 degrees Celsius) using a ceramic with ytterbium in it and researchers attacked that. The report proved wrong—the element was yttrium. (Ironically, the University of Tokyo lab later found, by coincidence, that ytterbium works. The lab patented the discovery.)

Finally at 3 a.m. March 1, they got to superconductivity. "It was an other-worldly experience," says Prof. Uchida. They drank a toast and launched back into another week of experiments, this time to refine the resulting ceramic. On March 8 they announced a purified form. On Wednesday the lab finally took a holiday.

Meanwhile, labs at Tohoku University, Hokkaido University and a government research facility in Tokyo have burst forth with rapid-fire announcements of their advances in superconductivity. They and other labs have been snatching up the ingredients for superconductors so fast that there are shortages. Suppliers have run out of yttrium, for example, and labs must wait three weeks for orders to be filled.

'The Real Thing'

Prof. Uchida's lab has been flooded by calls and visits from companies. Sumitomo Electric Industries Ltd. researchers brought in some rudimentary wire made from superconducting ceramic. Engineers from Toshiba, Fujitsu Ltd. and Hitachi have visited the lab to keep watch on developments. "Company people have the impression that this is finally the real thing and we are starting to pick it up. ... They say that superconductivity is a sure thing and they want to get on to applications," says Prof. Uchida.

Of course, there is scientific and commercial excitement in the U.S., too, but it's less frenetic and more carefully controlled. Scientists say indications of an impending breakthrough came as early as April 1986, when researchers at IBM's laboratory in Zurich, Switzerland, reported they had achieved superconductivity in a new class of materials, the metal oxide ceramics. This galvanized researchers throughout the world. By November, the Japanese and Chinese had confirmed the IBM discovery and by December, scientists in Houston and at American Telephone & Telegraph Co.'s Bell Laboratories were reporting important advances with the new materials.

About 3,000 physicists jammed the ballroom of the Hilton Hotel in New York Wednesday night for an unprecedented special session on superconductors at the annual meeting of the American Physical Society. They listened to the presentation of 50 papers on superconductivity research done largely within the last two to three months. Although scientists from U.S. corporations dominated the program, there were reports from IBM, Bell Labs, Westinghouse Electric Corp. and Exxon Corp. as well as from Japanese, Chinese and Canadian scientists.

The breakthrough generated tremendous excitement among Bell Labs scientists, says Robert A. Laudise, director of the laboratories' inorganic chemistry branch. "Usually research managers are

Crash Programs

In Japan, however, companies that already sell conventional superconducting wire in the U.S. have begun crash programs to commercialize the new discovery. Fujikura Ltd. and Sumitomo Electric, for example, say they have developed rudimentary wire out of the new ceramic despite skepticism among some scientists that the material won't lend itself to wire-making.

Like their U.S. [illegible] makers [illegible] ings that [illegible] the new ceramic superconductors [illegible] and how the [illegible]

Aside from [illegible] making brittle ceramic into wire, the new superconductors still [illegible] current to be used in heavy [illegible] as power plants. Superconductors also don't work well with [illegible] the type of electricity used in most of the world's power equipment.

But Japanese labs are [illegible] they can solve the problems [illegible] several years. Now that the West has made the basic breakthrough, they say, the ball is in their court. "It will be difficult and will take time," says Kazumasa Togano, a government scientist. "But this is the area where Japan's labs and makers have the edge."

Still, he and other researchers admit to a twinge of hurt pride. "To be honest, we're following in the footsteps of the U.S.," Mr. Togano says. "Once again the originality is coming from the West. We have a measure of sadness about that."

[illegible]

REFERENCE
#5

Science & Technology

DESIGNER PROTEINS: THE NEXT BOOM IN BIOTECH

The fledgling technology promises a generation of better drugs, plastics, and chemicals

On the computer screen it looks like an elaborately folded Japanese paper sculpture. But it is not three-dimensional origami. It is a map of a molecule that David A. Estell hopes to make more useful. By studying the twists and turns of proteins, the researcher at three-year-old Genencor Inc. is seeking ways to modify those complex molecules.

Estell is one of a group of scientists who are not satisfied with the way nature makes proteins. These so-called protein engineers are taking the next step in biotechnology. Unlike gene-splicers, who use bacteria to produce copies of hormones and other potential drugs, the protein engineers are deciphering the structure of proteins and changing them to produce a new generation of drugs, plastics, and industrial chemicals. "It is where genetic engineering was 10 years ago," says Ulrik V. Lassen, chief science officer at Novo Industri, a Danish drug and enzyme producer.

Even so, the potential is huge. The drug companies are aiming to produce "designer" drugs by changing the substances that are already made by biotechnology. That way they hope to devise drugs that last longer in the body, are targeted to disease sites, or have greater therapeutic effect. Furthest along, however, are efforts to alter delicate enzymes so that they will be more useful to industry, from food processing to fuel production. By 1995, predicts Menlo Park (Calif.)-based researcher SRI International, the U. S. market for products based on engineered proteins may top $1 billion.

WAIT AND SEE. Most major drugmakers, some leading chemical companies, and a few startups are pushing the new technology. Nor have the high stakes escaped the notice of foreign competitors: Britain has a small government-industry program, and Japan's Ministry of International Trade & Industry and a consortium of 14 companies are funding a $113 million, 10-year research program.

For now, however, protein engineering is still a hit-or-miss affair. To call it engineering "is presumptuous," argues Philip Bryan, a senior scientist at Genex Corp. in Gaithersburg, Md. Scientists have learned to analyze the structure of proteins and translate them into computer images. They can alter the order of the 20 amino acids that are the building blocks of all proteins. But the trick is figuring out which substitutions will improve the properties. So far, the only way is to make a new protein and see.

To do that, researchers usually turn to gene-splicing. They create a gene that provides the code for the protein in question. Then they modify the gene and test the resulting protein after it is produced in quantity by a microorganism such as a bacterium. In another technique, called "nicking" the protein, researchers remove small portions of the molecule until they find the section that makes it active. "We can make the genetic changes, but we can't predict what effect this will have," says Robert B. Freedman, a professor at Britain's Kent University who heads a protein engineering project.

The first products to move out of the lab are tailor-made enzymes for industry. These natural catalysts control a variety of chemical reactions, from aging

Science & Technology

cheese to changing starch into sugar. An estimated $450 million worth are used each year in food processing and other industries. But they are best adapted to mild environments such as those they find in living organisms—which doesn't always jibe with the needs of industry.

Genencor intends to apply protein engineering to turning out a generation of hardier enzymes. The company, founded as a joint venture of Genentech Inc. and Corning Glass Works, is spending nearly $5 million annually—about half of its research budget—on engineering new proteins. Among those under development is a modified enzyme that turns relatively inexpensive palm oil into a fat similar to more costly cocoa butter, an ingredient in candy and cosmetics. The natural enzyme breaks down fats.

In March, Genencor began supplying its first engineered enzyme to one of its research clients. And it expects to begin producing several more during the year. To Genencor President Robert E. Leach, that is just the beginning. "In 10 or 15 years, almost any enzyme used in industry will be engineered," he says. And his company is attracting additional investors: A. E. Staley Mfg. Co. bought a third of the company in 1985, and on Mar. 26, Eastman Kodak Co. took a 16% stake in the company.

WASHDAY WONDER. The startup hardly has the industrial enzyme field to itself, however. The companies that already dominate the enzyme industry are hard at work as well. One effort is aimed at improving stain-removing enzymes for household laundry detergents. The problem is that the natural enzymes now used are destroyed by high temperatures and bleaches. The Netherlands' Gist-Brocades has an enzyme that works with oxygen bleach. By substituting tiny portions of two amino acids out of the enzyme's chain of 275, the company's researchers have found that they can strengthen the enzyme's ability to ride through the wash cycle.

Others are working on tougher enzymes for such uses as chemical synthesis. General Electric Co. is experimenting with engineered enzymes to make new polymers. With the right enzyme, it might be economically feasible to make ingredients for plastics that are too costly to produce chemically. And the company is exploring altered enzymes to clean up pollution—especially polychlorinated biphenyls dumped into the Hudson River from a GE plant.

Du Pont is also jumping in. The company, says Mark L. Pearson, director of molecular biology, was "slow to recognize the interface between materials science and protein engineering." But now the chemical giant is investigating protein engineering as a means of making agricultural chemicals, plastics, and fibers. It is exploring proteins that could result in high-strength fabrics for plastic composites and materials for artificial bones and blood vessels.

Fibers are also the goal of tiny Syntro Corp. in San Diego, which has synthesized genes for a family of silk-like fibers that could be churned out by bacteria. BioPolymers Inc., in Farmington, Conn., is modifying the adhesive mussels use to stick to underwater surfaces to produce a medical glue that it believes could replace surgical sutures. And Repligen Corp., in Cambridge, Mass., sees protein engineering as the way to design better microbial pesticides. The company says modifying the molecule will increase its killing power tenfold.

The big breakthroughs in protein engineering won't come, however, until new methods take some of the guesswork out of correlating the structure of proteins with their behavior. Arieh Warshel, a chemistry professor at the University of Southern California, has devised a computer program that can predict some activity in modified enzymes. But even a Cray Research Inc. supercomputer took 10 hours to predict just one modification in a common enzyme. Says Warshel: "Most of our time is still spent on checking how well our methods work."

It will probably be years before designer proteins flood out of the laboratory. But the first hint of products—and the enormous long-term promise—has already transformed the field. "Protein engineering was once a laboratory novelty," says Michael E. Egan, product development manager at Repligen. "Now it's a necessity."

By Mimi Bluestone in New York, with Richard Brandt in San Francisco, Jonathan Kapstein in Brussels, and bureau reports

THE RACE TO ENGINEER NEW PROTEINS

AGRICULTURAL CHEMICALS
Du Pont, Monsanto, Repligen

PLASTICS AND FIBERS
Du Pont, Novo, Syntro, General Electric

INDUSTRIAL ENZYMES
Genencor, Genex, Gist-Brocades, Britain's Science & Engineering Research Council, MITI's Protein Engineering Research Institute, Novo Industri

MEDICAL ADHESIVES
BioPolymers

SPECIALTY CHEMICALS
Amgen, General Electric, Gist-Brocades

WASTE TREATMENT
General Electric

DATA: BW

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REFERENCE

SEPTEMBER

PETER BEHR

Does Kodak Have Any Home-Run Hitters?

Has Eastman Kodak Co. lost its home-run swing?

Kodak's struggle to hold on to its world leadership in photography troubles some analysts who closely follow the company, such as Mark M. Obenzinger of the investment firm Laidlaw, Adams & Peck Inc.

Although Kodak has introduced a stream of advanced products in the past year, from camera film to office printers, Obenzinger calls these "some bunts, some doubles, but no home runs." Lately, there have been no dramatically new products on the scale of the personal computer, the videocassette recorder or the instant camera that rapidly became $100 million-plus businesses. Kodak has been content with "good, continuous pursuit of their markets," said Obenzinger.

The question is whether this sort of an offense will be strong enough to keep the company growing in the face of increasing competition in all of its businesses: film, chemicals, office products and medical services. Can it win without the home run?

Kodak's answer may represent either realistic caution or self-defeating timidity. But it clearly spells a new attitude toward capitalizing on technology.

"The home runs of the next two decades are not going to be home runs by the definition of the last several decades," said Colby H. Chandler, Kodak's chairman. "You're going to see new products being more an evolutionary process result rather than revolutionary."

The reason? "American companies can't afford to fund the revolutionary process," he said.

Last week, the photographic and camera industry held its biennial display of new gee-whiz products, the Photokina exhibition in Cologne, West Germany.

The biggest splash was caused by Kodak's Japanese rivals, who showed off prototypes of electronic cameras that record images on miniature reusable floppy disks, like those that store information from computers. It is an emerging technology that some experts believe will eventually replace much of the color-film business on which Kodak depends. Japan's early commitment to this technology reminds some observers of a similar commitment by Japanese electronics companies to the costly development of videocassette recorders, an investment that won them a monopoly in that market.

There was no Kodak electronic camera, although Kodak is investing heavily in technology. Kodak's decision was deliberate, said Wilbur J. Prezzano, Kodak group vice president and general manager of photographic products.

After a hard look, Kodak was persuaded that electronic photography is too expensive to become a true consumer product for many years. The first such camera, introduced this year by Japan's Canon Inc., costs $2,000. A playback unit to show the pictures on a television screen costs $2,700 more, and a color printer to produce pictures is $7,000. In time, says Canon, the price of the camera and playback unit should drop to the equivalent of $800 in today's dollars.

Kodak's decision not to challenge the Japanese in commercial development was endorsed by Herbert Keppler, publisher of Modern Photography magazine. "The electronic camera is the wave of the future, but we're looking way out in the future. The camera is there, but the results are ghastly," Keppler said. He predicts that for a long time, electronic photography won't be able to match the cost, convenience and quality of color film. "Prezzano really told it the way it is," said Keppler.

But regardless of whose vision of the future is right, Kodak—like other major high-technology companies—has pulled back from big, costly commitments to new products. "Kodak sees a way to get into the whole consumer electronics home market, not by producing the revolution in its own ranks, but by taking positions in a lot of small companies," said Jacob E. Goldman, chairman of Cauzin Systems Inc., and former chief technical officer of Xerox Corp.

Revolutionary technological advances are more likely to come out of the small, innovative companies than a $10 billion giant such as Kodak, whose size slows its reaction time, and whose attention is concentrated on its existing businesses, said Goldman. But Kodak's own research efforts should make it smart enough to recognize the best opportunities developed by its smaller partners, Goldman said.

Other observers remain uncertain. "It's a question of what this patchwork of approaches add up to," said Obenzinger.

In any case, Kodak's cautious approach is unavoidable, said Goldman. Japanese consumer electronics firms enjoy an advantage over American rivals in their ability to pour money into projects like the videocassette recorder and the electronic camera, where the payoff may lie more than a decade away, Goldman said. "It's an R&D commitment that only the Japanese are prepared to make because of the whole financial structure of their industry. You're dealing with Japan Inc.—they can afford to take these long-term gambles," he said.

For a century, Kodak's position atop the photographic industry was based on its leadership in technology, which gave it the ability to control innovation, said Obenzinger. That overall edge is gone now and Kodak will have to create smaller technological advantages in a range of products and processes.

"For a company like us," said Chandler, "it will be as important in the future as in the past that we have technological advantages. The difference will be that no company will have that advantage over the whole market basket of products in the markets they serve." They'll have it in niches or in elements of the products they sell.

To compete, American companies will have to find ways to share and pool technology, Chandler said. "We desperately need in this country the ability for all of the collective strengths of American industry to be able to work together."

Los Angeles Tim

Tuesday March 17, 1987

REFERENCE
#3

It Takes Giants to Battle Japan in Chip Market

So new collaborative research efforts in microelectronic chip manufacturing and the possibility of $2 billion in support from the Defense Department are being proposed to save the U.S. semiconductor industry from extinction at the hands of Japanese competition.

No question that the intentions are good and the purpose important. U.S. hopes for continued technological leadership in world industry ride importantly on the electronic capabilities of American industry in the next five years.

But will the effort succeed? Will the Semiconductor Manufacturing Technology Consortium—in which chip makers such as Intel, Motorola, National Semiconductor and Texas Instruments, along with computer giant International Business Machines, pool money and resources in an attempt to come up with new ways to make memory circuits—save the semiconductor industry? A two-part answer: It may do some good for the industry we need to help, but it may not be enough to save the industry we know.

High Cost of Rapid Change

What that means is that it is getting so expensive to keep up with the rapid changes in semiconductor technology that only the bigger companies can afford it. A company has to invest almost $200 million to open up a line for a new semiconductor product today, and the technology is moving so fast that the latest innovation is obsolete in 12 to 18 months. That is why instead of small entrepreneurial companies announcing the latest advance in chip technology, we now have IBM pushing out the frontiers with a memory chip that holds 4 million bits of information.

Big computer makers such as IBM, and telecommunications giants such as American Telephone & Telegraph, can afford the investments such technological leadership requires. But even they have no desire to foot the bill on their own for keeping a strong U.S. electronics capability alive. And so they support the idea of multi-company ventures that will search for new ways to manufacture the all-important electrical circuits.

Such ventures are not looking merely to make the electrical circuitry a little denser—5 million bits, say, as opposed to 4 million. They will be looking at techniques such as X-ray lithography, which is the way electrical circuits will be implanted on wafers of silicon or other materials in the future.

What is happening is that the big computer and telecommunications companies, the end users of semiconductors, are fearful that their U.S. suppliers will fall behind in international competition and their own companies will be next in line.

Currently a Tie

Why should they be so fearful about electronic circuits etched on silicon wafers that sell for a couple of bucks apiece? Because the semiconductor assembly forms the essence of the product, the way the brain forms the human personality. The electronic circuitry defines the capabilities, and thus the efficiency and costs, of computers and communications equipment. Leadership in such products means the world flocks to your factories, as automotive engineers used to travel to Detroit—before they started going to Tokyo.

Right now, in the estimate of analyst James Barlage, of Smith Barney, Harris Upham & Co., the United States and Japan are tied, with 43% each of the $31 billion-plus world electronics market—leaving 14% for South Korea, Taiwan and the European companies. But they are tied because Japan has caught up.

Large Japanese companies such as NEC, Hitachi and Fujitsu, working from a protected home market, have mounted a fierce competitive drive that has brought them control in this decade of the important memory chip market and given them positions in all the other chip markets, including the most technologically advanced.

And now Japanese industry is moving on, trying to capture world markets in lithography and other equipment that makes the semiconductor chips. These markets still are led by such U.S. companies as Perkin-Elmer Corp. of Norwalk, Conn., and Varian Associates of Palo Alto. But they are under pressure as Japan—led by its Ministry of International Trade and Industry—appears to be aiming straight for world industrial leadership.

The collaborative industry-government efforts being talked about are the beginnings of a U.S. response to that challenge.

It's the end of an era too. The advent of billion-dollar expenditures to advance the technology and hold world markets, means that the much-admired bunch of small but vigorous electronics companies known collectively as Silicon Valley—Advanced Micro Devices, Intel, National Semiconductor and others—may soon become candidates for merger or acquisition by larger companies. They are too small, even at revenues of $500 million to more than $1 billion, to keep up. So their scientific capabilities will need the clout of big company capital budgets.

But their passing will be only a milestone, not the end of the road, if joint research efforts can help keep a strong U.S. electronics capability alive.

REFERENCE
#9

THE U.S. HAS THE ADVANCES, BUT JAPAN MAY HAVE THE ADVANTAGE

When a Houston laboratory announced a major advance in superconductivity research in February, Japan Inc. wasted no time. Its Ministry of International Trade & Industry immediately began assembling a consortium of government, industry, and university researchers. A MITI official describes the ministry's goal with missionary zeal: to exploit the "fantastic world of future industries" promised by new materials that conduct electricity with virtually no loss of power.

Both leading U.S. universities and major industrial companies such as International Business Machines Corp. and American Telephone & Telegraph Co. are playing a pioneering role in the spectacular scientific advances. But some experts fear that the Japanese ability to organize their research into a program with strong commercial goals could give them the edge in moving the research out of the laboratory.

At the moment, declaring a winner in the superconductivity race is premature. But leaders of the nation's science Establishment marvel at the speed of MITI's action. "I wouldn't call what they have done ominous, but it certainly is a sign of intensifying aggressiveness," says Roland W. Schmitt, General Electric Co.'s chief scientist and chairman of the National Science Board. Adds Carl H. Rosner, president of Intermagnetics General Corp.: "The Japanese have long recognized the tremendous potential of superconductivity, whereas the people in this country have been very shortsighted."

[illegible] No one government agency coordinates U.S. attempts to exploit the new science. Nor does anyone know precisely how much the U.S. spends on superconductivity research. But the National Science Foundation, which funded much of the recent U.S. research, estimates that federal agencies are funneling at least $8 million a year to universities.

American scientists and industrialists share the assumption that, as in the past, the U.S. system doesn't need a push from the government to bring innovative technologies to market. "The discoveries have been so spectacular that the level of activity is enormous in every laboratory in the U.S. with any capability in superconductivity," argues Schmitt. And Frank Press, president of the National Academy of Sciences, notes that a surprising amount of the academic work is aimed at applications of the new knowledge, such as thin superconducting films for computer chips.

But not everyone is satisfied. Ching-Wu "Paul" Chu, the University of Houston physicist who is the leading U.S. superconductivity researcher at the moment, thinks more action is needed to meet the combined weight of Japan's governmental, financial, and industrial resources. "We cannot afford not to move the same way as the Japanese," he says. "We really have to have a coordinated effort this time." In between these standing pat and the activists, there are a lot of people just scratching their heads. "Maybe," says one official half-jokingly, "what we ought to do is have some kind of conference to see what we ought to do."

[illegible] But one aggressive government science administrator is not waiting. James A. Ionson, the astrophysicist who heads the Office of Innovative Science & Technology for the Pentagon's Strategic Defense Initiative Organization, is already busy forming his own consortium. He has lined up an unnamed university, a federal research laboratory, and a handful of small companies. Ionson's consortium will have a specific target: vastly improved space-based infrared sensors for detecting enemy missiles. "My concern is that if we don't pull the science into a technology fast, we're going to be beaten to the punch," says Ionson. "I think we've got to build the first widget."

Early proof that the science can be converted into a product might, as Ionson hopes, be enough to spur vigorous development. But there are no guarantees. Even in the basic science, the international competition is fierce, and other nations are already scrambling hard for products because the potential payoffs appear to be so great. Furthermore, there are signs that the time from discovery to application may be exceptionally short.

Superconductivity is likely to be a severe test of the highly individualistic American system. Even as basic findings are still pouring out of the laboratories, the stark reality of the competitive marketplace looms. And Ionson's embryonic consortium is no match for MITI's directed Japanese effort. In this case, the U.S. may have to consider imitating Japan for a change.

By Evert Clark in Washington

REFERENCE
#10

Economic Watch

U.S. FARM POLICY IS A CORNUCOPIA OF MISTAKES

BY ROBERT KUTTNER

America's contradictory and self-defeating approach makes life worse for farmers in every country. It's time the U.S. took the lead in drawing the outlines of a stable agricultural economy

During the early 1980s, as the U.S. trade imbalance in manufactured goods worsened, we were assured that America's competitiveness in agriculture would come to the rescue. Instead, the positive balance in agriculture has steadily declined—from $26.6 billion in 1981 to $11.4 billion last year. In May, despite the cheaper dollar, the U.S. had its first negative farm trade balance in a generation. And even with such one-shot deals as the Soviet wheat sale, that imbalance is likely to grow.

To understand what happened, one must first consider the logic of the farm economy. Agriculture is probably the most striking exception to the textbook theory of a self-regulating economy. Farmers make expensive investments in land, mechanization, fertilizers, and labor. In a free market, crop prices tend to fluctuate based on such imponderables as the weather. In most sectors of the economy, when prices drop, the producer rationally decides to cut production. But when farm prices drop, each individual farmer redoubles his effort to sell what he has planted and recoup what he can, further depressing prices.

Since the 1930s the U.S. government has stabilized the farm economy by supporting prices. Supports enable farmers to invest profitably for the long term. But when prices are artificially held above the free-market price, overproduction results. To counteract that tendency, the government also has relied on incentives, usually acreage controls, to limit output. Although farm policy has been an inelegant patchwork, until the late 1970s it worked reasonably well, producing both a profitable farm economy and cheap food.

HIDDEN INGREDIENT. The hidden ingredient in the success of farm policy was insulation from imports. If the domestic price is held above the world-market price, you can't have free trade. In some crops, such as soybeans, the U.S. enjoyed a competitive advantage. In others, such as meats, peanuts, or cotton, we simply blocked most imports. Despite our own protectionism, we could enjoy an export surplus because most of the world didn't have enough food.

But in the past decade, world agriculture has made great productivity gains. In much of the Third World the famous "green revolution" has done the trick—supported, ironically, by U.S. foreign aid. India is now a net exporter of farm products. Advanced nations also have emulated the U.S., holding domestic prices above the world price, thereby subsidizing mechanization. The European Community is now more than self-sufficient in food. EC grain output went from 91% of domestic consumption in 1973 to 108% in 1982—to a projected 127% in 1990. Although the U.S. and the Europeans regularly denounce each other for protectionist sins in agriculture, both rely on essentially similar combinations of price supports, import restrictions, and export subsidies.

Meanwhile, the U.S. has struggled to compensate for falling farm income. The pre-1985 farm program, for example, set price supports high, allowing foreign producers to underprice U.S. producers in Third World markets. The 1985 farm bill lowered support prices on the theory that this would make U.S. products more competitive. To compensate farmers for the loss of income, the bill gave them "deficiency payments," a backdoor form of export subsidy. But other nations continue to underprice U.S. farmers, setting off exactly the kind of price war, coupled with chronic overproduction, that our domestic program was designed to avoid.

That's the rub: a globalized farm economy that reproduces all of the instabilities of unregulated farm production in a single country but with none of the stabilizing mechanisms. It's hard enough to put a floor under farm prices in a sovereign nation. How do you do it worldwide? Nobody, not the tin cartel, not even OPEC, has succeeded in stabilizing commodity prices internationally.

[illegible]. America's agricultural trade policy today is an extreme case of contradictory, self-defeating goals. To rescue farmers, we have turned to export subsidies. Yet we still are encouraging Third World producers to increase their own exports to pay their debts to U.S. banks. This adds up to terrible overproduction and falling prices, making every country's farmers worse off. According to a recent congressional Joint Economic Committee report on Third World debt, Argentina increased its export volume by 43% from 1980 to 1985, mostly in agriculture. But because of falling commodity prices, its export earnings went up only 3%.

Even more ironic, official U.S. policy is to push for even freer farm-goods trade. In negotiations we have pressed our trading partners to put agriculture on a fast track—on the dubious premise that laissez-faire agriculture will increase U.S. farm exports. In fact, Canada, New Zealand, Australia, and much of Latin America can underprice large sectors of the American farm economy. Instead of promoting laissez-faire on the one hand, and export subsidies on the other, the U.S. should take the lead in thinking through the outlines of a stable world farm economy. That will be difficult under any circumstances—and impossible if we don't face facts.

[illegible]

4 Electronic Engineering Times — Monday, March 16, 1987

REFERENCE
#11

White House Group To Weigh Sematech Alternatives

WASHINGTON — A White House Science Council study group has 30 to 60 days to compare the proposed Sematech manufacturing technology joint venture with alternatives for reviving the U.S. semiconductor industry.

The deadline for a final report to William Graham, President Reagan's science adviser, is about two weeks before a Semiconductor Industry Association task force is scheduled to complete an action plan for Sematech.

Meanwhile, the Defense Department—a near-certain participant in any government moves to help the ailing chip makers—is reviewing options with the National Science Foundation, the departments of Commerce and Energy and the Office of Science and Technology Policy, said Ronald Kerber, deputy undersecretary of defense for research and advanced technology.

The Pentagon wants to determine the best course of action to help the industry help itself, Kerber said during a hearing last week before the Senate Armed Services subcommittee on defense industry and technology.

Graham declined to predict when the Reagan administration would decide whether to back a $1-billion-plus Sematech, endorse a less costly aid plan, or opt for no further government intervention in semiconductor industry affairs.

The White House Science Council study group will work quickly to produce a preliminary report by mid-April and a final report a month later, Graham said. His office then expects to make technical development and investment proposals to address the semiconductor problem, he added.

Kerber said a proposed two-year $100-million Semiconductor Manufacturing Technology Initiative would focus on technologies to improve the manufacturing capabilities of domestic semiconductor producers who supply devices for defense systems.

The project was included in the Defense Department's latest budget request before SIA endorsement of Sematech earlier this month paralleled an earlier Defense Science Board recommendation that government and industry undertake a joint venture to revive lagging U.S. capabilities in semiconductor manufacturing technology.

The initiative, Kerber said, would stimulate the semiconductor industry to develop advanced semiconductor materials, processing equipment and manufacturing methods needed to maintain a viable and competitive domestic source for semiconductors and integrated circuits.

The semiconductor problem is an "enormously important issue" that could produce a model for public-private partnership that could become extremely important for other industries, said Sen. Tim Wirth, D-Colo.

"I am encouraged to see several industries, including most prominently the semiconductor industry, coming forward with plans for cooperative research projects on high risk, generic manufacturing technology," said Sen. Jeff Bingaman, D-N.M.

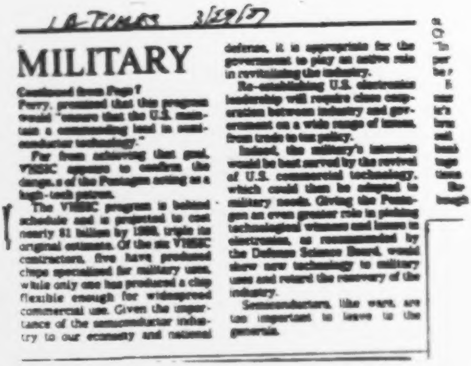
"We are going to examine these initiatives very carefully to see where they can profitably be expanded into other sectors of our defense industrial base," he added.

The Senate hearing and a meeting of the House Energy and Commerce subcommittee on competitiveness were the first of what is likely to be an extensive round of congressional sessions to review the SIA and Defense Science Board proposals.

Among other comments:

- "We have a variety of techniques to help this very important industry, and we should use them," said Frank Press, president of the National Academy of Sciences. The government has helped many key industries in the past, he added.
- "I don't favor subsidizing the semiconductor industry. [But] national security issues may be involved. The Defense Department may have to take steps to protect defense capabilities," Graham said.
- The Pentagon does not view these proposals as a subsidy, Kerber said. The $200-million-a-year contribution that is envisioned as the government share of the five-year Defense Science Board joint venture is not very much, he added. The Defense Science Board report supports "help to the industry to get itself out of the slump that it's in," said Erich Bloch, director of the National Science Foundation.

REFERENCE
#12



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Perry, promised that the program would "ensure that the U.S. maintain a commanding lead in semiconductor technology."

Far from achieving that goal, VHSIC appears to confirm the dangers of the Pentagon acting as a high-tech patron.

The VHSIC program is behind schedule and is projected to cost nearly $1 billion by 1989, triple its original estimate. Of the six VHSIC contractors, five have produced chips specialized for military uses, while only one has produced a chip flexible enough for widespread commercial use. Given the importance of the semiconductor industry to our economy and national defense, it is appropriate for the government to play an active role in revitalizing the industry.

Re-establishing U.S. electronics leadership will require close cooperation between industry and government on a wide range of issues, from trade to tax policy.

Indeed, the military's interests would be best served by the revival of U.S. commercial technology, which could then be adapted to military needs. Giving the Pentagon an even greater role in picking technological winners and losers in electronics, as recommended by the Defense Science Board, would skew new technology to military uses and retard the recovery of the industry.

Semiconductors, like wars, are too important to leave to the generals.

REFERENCE
#14

Why We're Behind in Technology

U.S. Education Isn't Producing World-Class Competitors

By SIMON RAMO

Every nation now perceives its strength to be vitally dependent on its technology. This is creating an international contest for technological superiority, a world technology Olympics. By winning many competitive events a country can be master of its fate. To lose too often can be catastrophic.

For decades the United States swept the technology Olympics, but recently we have been slipping badly. American producers have been bested in consumer electronics, cameras, automobiles and many machinery fields. The U.S. share of world trade in high-technology products has dropped from 30% in the 1960s to less than 20% in the 1980s. America's 1980 trade surplus of $17 billion turned into a deficit that totaled $169.8 billion in 1986. Twenty years ago the U.S. Patent Office's grants to foreigners were barely noticeable. Now foreign inventors are obtaining almost half of American patents.

We have gone from world leadership in annual improvement in productivity (output per worker hour), the key to high living standards, to the bottom of the list. During the 1970s, the productivity increases in France and West Germany were twice ours—Japan's three times. In the middle 1960s we ranked first in the world in capital investment per capita. By the middle 1970s we had slipped to sixth place. U.S. investment in new non-defense technological facilities as a percent of GNP is now less than that of any other developed nation.

The situation cannot improve soon because America turns out only seven engineers for each 1,000 college graduates. For Japan the figure is 40. The Soviet Union now graduates five times as many engineers as does the United States. The fraction of scientists and engineers in our labor force has declined in the last two decades while that ratio has doubled in both Japan and Germany.

The rate of producing Ph.D.s in engineering is an excellent indicator of future technological strength. In an ever more technological society this number should rise steadily. But American universities now award only about 2,500 doctoral degrees in engineering annually compared with the figure of more than 3,000 a decade earlier, and foreign students now are obtaining almost half of these doctorates. In the last decade U.S. corporations with operations abroad have almost doubled the amount of research and development that they have conducted in foreign countries. To remain competitive, American industry must expand in certain critical fields, such as computers, while our universities are becoming short of professors and graduates in those promising areas.

The future of America's technological stature appears even worse as we look back along the pipeline to basic education in science and math. Our grade school students typically spend only one hour on science and four hours on arithmetic every week. Only about 100,000 U.S. high school students study calculus, and for only a part of a year. Five million Soviet high school students receive a full two years. Half of those teaching mathematics in our nation's high schools do not possess the minimum requirements and hold only temporary certificates. More than half of all our high school graduates have not had even one year of science. Of 25,000 high schools in the United States, only 7,500 offer a physics course. In the last decade shortages of teachers and funds have forced many high schools to delete science laboratories.

How could the United States have moved so quickly from preeminence in technology to such diminished future prospects? There is plenty of blame to go around. The parents of American school children, for example, spent billions of dollars to buy their children computer games (useful for entertainment and developing quick eye-hand coordination but not for learning either mathematics or computer science) but, every chance they had, they voted against more funds for superior schools.

Perceiving the coming crisis in the nation's critical technological strength, the federal government, through the National Science Foundation, has begun new programs to stimulate improved elementary education in science and math. Federal government leadership is important for elevating the priority of education and it is reassuring that it is at last being exerted.

But the real power to influence elementary and high school education lies with lower government levels. Here the parents and the citizenry as a whole are failing to assert their political strength. They are not demanding that political bodies at state, county and city levels recognize the seriousness of the problem and attack it with vigor. In California, for instance, the nation's largest state, one whose economy is highly dependent on the quality of education of its population, the voters are willing to tolerate a lower allocation of education funds per child than the national average.

If apathy and lack of appreciation of primary and secondary education should prevail, we are headed for technology mediocrity and a lowered American standard of living.

Dr. Simon Ramo, director emeritus and co-founder of TRW, has just completed a two-year term as chairman of the Education and Human Resources Committee of the National Science Board.

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NATIONAL POLICY AND TECHNOLOGY FOUNDATION ACT OF 1985

HON. GEORGE E. BROWN, JR.

OF CALIFORNIA

IN THE HOUSE OF REPRESENTATIVES

Thursday, April 24, 1986

Mr. BROWN of California. Mr. Speaker, today I wish to discuss for the consideration of my colleagues, the National Policy and Technology Foundation Act of 1985 that I recently introduced as H.R. 3997. Joining me as cosponsors of the bill are Congressmen Beilenson, Berman, Bonior (MI), Conyers, Crockett, Dixon, Dymally, Edgar, Fazio, Ford (MI), Guarini, Hawkins, Hertel (MI), Levine (CA), Lundine, MacKay, McKinney, Mitchell, Nelson (FL), Panetta, Rangel, Torres, Udall, Walgren, Waxman and Weiss.

[illegible] National Policy and Technology Foundation Act was introduced to focus congressional attention on the need for legislative [illegible] and the correction of structural deficiencies in our basic governmental institutions that threaten the long-term economic foundations and quality of life in the United States.

INTRODUCTION

Sometime, nearly four decades ago, with the United States enjoying the world's highest standard of living and a seemingly invincible industrial plant, the Nation's industrial base began to erode and the country's quality of life entered into a long-term decline. Held captive by past success and its own conventional wisdom, the Nation ignored many danger signs. Finally, in the late 1970's and early 1980's the loss of consumer electronics markets, followed by steel and automobiles, made it clear that America's leadership and prosperity were being lost—perhaps forever.

The country is experiencing a broadly based structural phenomena that is indescribable in terms of classical economic models. The regression of American trade and economy are being matched by a concurrent deterioration of the relative American life quality. If the trend of the past 40 years foretell America's future, our children will have much less to be thankful for than their parents.

Industry provides most of the material goods of our society and generates much of the revenues used to finance our social services. However, by almost any standard, American industry is ill and shows few signs of re[illegible] its ability to compete in world markets. Th[illegible] statistics documenting the United S[illegible] inability to meet current international competition are too well known to repeat. The LICIT Report of April 1983 presents a grim picture of world market share trends. During the 15-year period from 1965 to 1980, in 12 major manufacturing categories ranging from iron and steel to aircraft and computers, France and Japan each increased their percentage of world market share in 8 categories. West Germany increased its share in five categories and now leads the United States (8 to 4). United States' market share on the other hand declined in 10 out of 12 categories. The result of our eroding industrial competence is a $150 billion U.S. trade deficit for 1985 and a drop in relative U.S. GNP/capita from first place after WWII to 10th place today. The President's Commission on Industrial Competitiveness points out: "Real hourly compensation in the United States has remained virtually stagnant since 1973. Since 1979 it has actually declined."

National life quality is obviously influenced by the national GNP/capita, but the actual quality of life is given by other environments such as education, health, personal security, pollution, etc. In each of these areas, the United States life quality is not outstanding.

Educational test scores have been dropping steadily in the United States while functional illiteracy remains at close to 20 percent. Our ability to allocate our educational resources to effectively serve national needs is questionable. During the past decade, with high technology industry often struggling to satisfy its demand for experienced engineers, California's production of electrical engineers decreased by nearly 30 percent while the output of lawyers increased 300 percent. It would seem that we plan to litigate our way back to industrial preeminence. Japan, on the other hand, produces twice as many engineers as the United States, but the entire country employs fewer attorneys than are found practicing in Los Angeles County.

In spite of our enormous investment in medical research and health delivery, Americans are not relatively healthy. Today the Japanese and the Swedes, contributing little to medical science, are the world's healthiest people with the lowest infant mortality rates and the longest life spans.

In other life quality areas the country is doing no better. Crime is excessive; the average American is more conscious than ever of muggings, burglary and widespread use of narcotics. The Nation's physical environments are being damaged by pollutants. Acid rain is destroying Eastern forests and lakes. Smog levels in our major cities remain high.

WHY A NATIONAL POLICY AND TECHNOLOGY FOUNDATION?

Centralized national planning is neither practical nor desirable for our society. Large scale national plans take so long to produce and put in place that the dynamics of a modern industrial society render such plans obsolete before they can be implemented. Central national planning, therefore, is simply not useful.

On the other hand, only the Government can take responsibility for the creation and maintenance of coherent national policy in the national interest. Rational planning and investment by the private sector, individual and corporate, cannot exist independent of government policy. In reality, the very rationality of a business decision almost inevitably depends upon its consistency with national policy. Conversely, in the face of inconsistent, incoherent, conflicting or invisible national policy, private planning and investment becomes a high stakes gamble instead of a reasoned exercise.

Congressman Leon E. Panetta of the House Agricultural Committee in the Los Angeles Times, May 12, 1985, said: "Counterproductive and conflicting Federal laws and policies abound in agriculture to the point where they sometimes sound like 'Alice in Wonderland' creations. For example there are Tax policies that encourage investors to begin raising unneeded, irrigated crops on easily erodible soil in Nebraska using scarce water at the same time the Government is fighting soil erosion and looking for ways to conserve that water."

Allen Paul, President of the Agriculture Council of America observed: "There ain't nobody responsible, nobody accountable . . . We just don't have an integrated farm policy."

The consequences of inconsistent national policy appear everywhere. Monetary policies established to combat inflation contribute to an overpriced dollar that made U.S. goods uncompetitive in world markets and created a $150-billion trade deficit. Conflicting macro policies, which frequently insulate economic sectors from market forces, drive U.S. farmers bankrupt and allowed Argentine wheat to be delivered in Minnesota at less than U.S. cost.

The problem is deep-seated. Institutional rigidity has precluded changes in our basic institutions and institutional deficiencies insured that the need for change was not perceived. The country's present institutional structure is flawed and unsuited for the dynamics of a modern world—lacking means to facilitate the integrated public-private policies so necessary to the country's long term interest.

Policy conflict begins at the data level with micro information gathered by very specialized agencies charged with making micro policy. There are no mechanisms to gather data on a more global basis, assess the consequences of both micro and macro policy and propose the modifications necessary to create integrated, coherent and consistent national policy in the long term public interest.

Although every Government department and most important agencies have policy sections, their scope is generally limited to gathering micro data to provide micro policy for their host. Regardless of capabilities or desire to do more, they are restricted both by the data available and their findings. Even if adequate data were made available, the United States has not established a formal system for monitoring the international trends and developments that impact our economy and quality of national life. Commercial opportunities arise and are forever lost while economic challenges mature into major crises without an early warning system to alert our Government and industry.

Micro policies proliferate within major Government departments with little analysis of their interaction and collective effectiveness. Macro policy is created, often in response to an ideology and with negligible assessment of long-term consequences. The experimental and changing nature of national policy is largely ignored. Formal means to evaluate policy consequences are seldom enacted. National policy is almost entirely reactive. A 40-year decline in international trade competitiveness is recognized only after much of American industry has been driven off shore and exploding trade deficits make the United States a debtor nation for the first time in 70 years.

It is at the integrated policy structure level that the U.S. institutional deficiencies become most painful. Means do not exist to consider, much less assess, the interrelationship between national macro policies such as monetary policy, inflation policy, trade policy, industrial initiatives, tax policies, saving policy, life quality policies, etc. The Nation does not possess institutions capable of preparing integrated national policy alternatives and assessing their expected long term consequences. Until this deficiency is relieved, the Nation will continue to dissipate its considerable resources and stagger from one avoidable crisis to another.

In recent years the consequences of the Nation's institutional deficiencies have become more evident. Failures of the formal national policy making system have finally culminated in the Gramm-Rudman Act.

Gramm-Rudman represents a massive breakdown of the legislative process. The act was passed by a frustrated Congress unable to resolve a runaway budget crisis. But Gramm-Rudman is not the first nor will it be the last of major national issues for which the Congress and the administration will be unable to provide adequate national policy. Like the Social Security crisis of 2 years ago Gramm-Rudman flows basically from structural and institutional deficiencies and not from a lack of dedication or the desire to perform by the Congress or the administration.

The Nation's leading trade competitors have long enjoyed well established institutional means for developing national policy and obtaining the necessary public consensus. Germany's Stability and Growth Act of 1966 established a tripartite consultation process among labor, business, and government. Japan's MITI has 35 associated independent councils with over 200 standing committees that insure the effective participation of every segment of Japanese society.

Unlike our trade competitors, the U.S. Congress simply does not have the tools to cope with the far-reaching complexity of the problems of a modern global society. Without the means to anticipate pending crises before they become critical, develop an adequate data base, formulate and assess policy alternatives and in particular, generate the national consensus necessary for public acceptance, the United States is assured of a future with more Gramm-Rudmans.

The country needs to put in place the means to recognize world change that will require adjustments in its national policies and it needs the means to effectively initiate and facilitate policy change. Specifically, a consensus-driven mechanism is required to rationalize national policy by anticipating changing conditions, assessing the long term consequences of existing and proposed policy and recommending to the Congress and the President self-consistent, mutually supporting national policies. With continually changing world markets and international competition that shapes its policies and strategies to match the changing market, it becomes axiomatic that the United States must be able to readily reshape its policies and institutions for compatibility with the changing times.

The Nation's policy facilitating agencies are also incomplete. Although the Federal Government now provides substantial funding for science, and technological support for selected industries such as agriculture, aviation and commercial fisheries, we presently lack the institutional capacity and civilian agencies to focus programs upon the competitive performance of our economy as a whole. Congress has responsibility for designating the appropriate agencies to implement national policies. In practice, however, implementation of important policies may languish for lack of an existing competent agency to pursue them. In the broadest sense, the Nation does not possess for our new technology development needs the equivalent of the National Science Foundation or the National Arts and Humanities Foundations. The National Policy and Technology Foundation would consolidate technology related activities which are not now closely tied to an agency mission and would insure that the Federal Government will assume such responsibilities for needed civilian technology which have heretofore not been adequately discharged by any sector of society.

The combining of existing governmental functions into a new foundation with responsibility for facilitating national policy and the technology supportive of that policy finds its counterpart in the principal policy agencies for some of our major trade competitors. Japan's MITI is heavily involved in insuring the excellence of that nation's technology.

NEEDS ADDRESSED BY THE NATIONAL POLICY AND TECHNOLOGY FOUNDATION

While it might be convenient to blame the Nation's present difficulties upon one or the other political party or upon a particular ideology, this would belie the facts. Our regression has steadily progressed for nearly 40 years under the stewardship of both parties. The data would demonstrate that the United States is in the midst of a long-term decline resulting from 200-year-old structural deficiencies that render our institutions incapable of discharging the policy responsibilities of a modern society. The rigidity and structural deficiencies of America's basic institutions have existed so long, they are almost impossible to perceive or to question. John Kemeny, Chairman of the President's Three Mile Island Commission, after studying that disaster, was forced to the conclusion that the fault lay more with obsolescence of U.S. institutions than with the reactor operators. "The present system does not work. It was designed for a much earlier and simpler age. The only way to save American democracy is to change the fundamental decision-making process at the Federal level, so it can come to grips with the enormous and complex issues that face the Nation."

To confront most large scale national problems, the Congress has need for effective, nonpartisan institutional means for creating coherent, consistent national policy in the public interest. Indeed, there is often great difficulty in recognizing or even defining long term public interest. When faced with complex, legitimate, and conflicting demands, our national institutions are too often inadequate, causing the political process to fail.

The National Policy and Technology Foundation has been designed as an effective, efficient, nonpartisan national policy mechanism. Existing agencies and bureaus are brought together to provide Congress with the badly needed early warning system, comprehensive policy data base, policy assessment and the public consensus necessary to reduce legislative gridlock. The Foundation draws upon the lessons learned from the policy institutions of our more successful trade competitors and from our own national experience to offer a bipartisan approach to achieving and facilitating integrated national policy.

The number of studies and congressional bills addressing various manifestations of America's loss of economic and industrial leadership has been increasing. The pressures of the times are seen to be forcing the restructuring of the basic institutions necessary to maintain the national life quality and trade competitiveness. The administration has considered two significant reorganization initiatives involving the creation of two new Cabinet level agencies: a Department of International Trade and Industry [DITI] and a Department of Science and Technology. At the same time, thoughtful proposals such as those by the President's Commission on Industrial Competitiveness and the House Republican Research Committee have invariably come to propose major changes in national policy. There has been a direct or at least tacit recognition that the Nation's need to resolve complex national issues such as trade competitiveness requires the addressing of a host of national policies in a coherent manner.

The House Republican Research Committee's "Agenda for Meeting America's Competitive Challenge" targets the process of innovation to improve the Nation's competitiveness. While the agenda does not directly address the general issue of conflicting national policies, its emphasis is upon the broad spectrum of national policies that must come together to improve our trade competitiveness. The impact upon U.S. trade competitiveness of monetary policy, tax policy, education and retraining policies, trade policy, capital formation policy, intellectual property policy, antitrust policy, national R&D policy and regulation policies has been carefully defined. The proposed Foundation is structured to provide long term attention to the national policy issues that the "agenda" has raised.

America's declining ability to compete in the international marketplace is one of the more serious consequences of the structural deficiencies of our country's national policy institutions. The President's Commission on Industrial Competitiveness [Young Commission] de-

pelled many of our most cherished tradi- he. Four institutional policy needs are ed in the Young Commission report that ate with the basic functions of the Foun- on. The Foundation would provide:

1. A high quality, comprehensive readily accessed international and domestic information and data base.

The Young Commission observes: "One reason few U.S. firms export is that they lack critical information about foreign markets. Such information currently exists within Government, but it is not readily available."

2. First rate, independent capabilities for the analysis of national problems and opportunities and the assessment of policy alternatives—their interdependence and interaction.

The Young Commission found "The competitiveness issues facing America today are not new, yet they remain unsolved. The ability of the political decision making process to deal with them is impeded by conflict among the very sectors needed to solve the problems we face. Policy makers must deal with widely disparate points of view presented by a diversity of interested parties. Often there is not even agreement as to the facts of the issue much less a shared understanding of the tradeoffs in the policy options under discussion."

3. Highly visible neutrally representative means for achieving national policy consensus.

The Young Commission recommends "Government can be strengthened signifi- ntly by providing a forum in which con- sus can be reached on the facts of an ue and in which implicit tradeoffs among cy options can be made explicit."

Means to facilitate and implement those policies for which there is no presently existing suitable organization.

The Young Commission wrote "... we should be concerned by the fact that the Federal government conducts its R&D ... in agencies and organizations with no common management. Each research entity has a mission independent of the others and none has industrial competitiveness as a goal."

DESCRIPTION OF THE BILL

The National Policy and Technology Act of 1985 establishes the Foundation as an independent agency in the executive branch of the Federal Government.

STRUCTURE OF THE FOUNDATION

The Foundation would have nine main branches and appropriate independent public councils.

First. The National Information Office.—This office would develop in cooperation with other public and private agencies, the comprehensive, coherent National Information and Statistics Policy necessary to the creation of a National Information System.

Information and data required for the informed, effective operation of the Nation's public and private policy makers would be provided. The basic factors influencing the national economy and life quality would be continuously monitored including United States d foreign Economies, trade, production, rket and industrial trend indicators, cu- es, tariffs, regulations, commodities, energy, ket opportunities, technological innovation, scientific advances, industrial competitiveness, industrial policy and strategy, government and business policies, educational policies and resource allocation strategies.

A national computer network with remote terminals would provide ready access to the national data base by public and private users.

The National Technical Information Service of the Department of Commerce would become part of the National Information Office.

Second. National Office of Policy, Analyses and Assessment.—This office would provide a vehicle for comprehensive examination of the U.S. policy structure. Interrelationship of existing and proposed national policies including life quality, societal, economic, industrial, monetary, et cetera, policies and their combined future impact upon the Nation's standard of living, international competitiveness, industrial competence and technological development would be continuously evaluated. Particular attention would be given to conflict between micro policies and the coherence and consistency among macro policies needed to form integrated national policy.

Drawing upon the data banks of the National Information Office, the Policy Office would provide an early warning system to identify emerging national and sectoral problems, opportunities and needs before they assume crisis proportions. In cooperation with existing Federal policy groups and other concerned public and private bodies, critical issues would be evaluated. Alternative policies and programs to resolve national problems, needs and opportunities would be assessed and furnished to the appropriate councils for public resolution and debate. The evaluations and assessments of the Office of Policy would serve as points of departure for the public deliberation of the councils. The National Science Foundation's Division of Policy Research and Analysis would be transferred and serve as the nucleus of this office.

Third. Office of National Programs.—The office would undertake the applied research and development required to develop proposed policies in those areas of national concern not adequately supported by other agencies or the private sector. Cooperative industry, government, university and professions programs would be encouraged and facilitated. Commercialization and deployment of resulting new technology would be the responsibility of the private sector. Typical large scale one time national programs could be the fifth generation computer, the unmanned garment factory, and the very high speed, large scale integrated circuit program which went by default to the DOD. The National Science Foundation's Applied Research and Problem Focused Research Divisions would be transferred to form the initial core program of the Office.

Fourth. Office of the Professions.—The office would support fundamental research in the engineering disciplines and nationally needed development and applied research in public professions not adequately supported from other sources. The National Science Foundation's engineering divisions would be transferred to the Office of the Professions and could constitute the initial programs of the Office.

Many critical national issues require multidiscipline, multiprofession resolution. Mechanisms including cross-disciplinary and multiprofessional activities would be investigated to facilitate implementation of cooperative public-private understandings in the national interest.

Fifth. Office of Institutional and Human Resources Development.—This office would include the Centers for Industrial Technology authorized by Public Law 96-480. The Office would have responsibility to join government, university, industry and professions in cooperative activities including generic development useful to many industries and training of individuals for innovation, industrial competence and international competitiveness.

Cooperative government, industry, university, and Federal laboratory efforts to establish technical and economic feasibility in the matter of Government mandated industrial health, safety, and environmental regulation, would be important activities of the Centers. Technological and societal systems needed for long-term resolution of major industry-environmental questions such as acid rain, would be considered.

Quantitative projections of human resources needs would be made. Training and retraining programs, new curricula and educational institutions to meet these needs along with those caused by technological displacement and the unmanning of the Nation's factories would be proposed. Encouragement and assistance for minorities and women to enter the professions would be offered.

Sixth. Office of Small Business.—This office would materially improve the resources and capabilities of U.S. small business, including upgrading production technology by grants and incentives for cooperative industry-wide development and research, promotion of computerization, training of personnel, et cetera. The small business innovation program of the National Science Foundation would be transferred to the National Policy and Technology Foundation.

A major undertaking would be the creation of the Federal Technology and Professions Extension Service to be the counterpart of the U.S. Agriculture Extension System. Ready access would be provided for individuals, companies and industries to advice, support and expert consultation upon the latest manufacturing processes, management systems, quality assurance methods, production techniques, personnel procedures, computer applications, financial controls, et cetera. These programs would be coordinated with existing State technology, professions, or industrial programs to avoid duplication or adverse impact.

Seventh. Office of Intergovernmental Technology and Professions Delivery System.—This office would facilitate the integration of the latest professions delivery system and technology advances into the policy formulation and delivery systems management of State and local governments. Cooperation between government (local and State) with the university's professional schools would be supported. The Office and universities would offer resources particularly suited to massive problems such as solid and toxic waste disposal that go beyond the resources and boundaries of conventional jurisdictions. The intergovernmental programs of the National Science Foundation would be transferred and serve as the nucleus of this Office.

Eighth. National Bureau of Standards.—The Bureau would be transferred intact from the Department of Commerce to serve as an operating laboratory for the Foundation. Present duties and programs of the Bureau are quite compatible with Foundation responsibilities. Where appropriate, mechanisms would be developed to foster public-private partnerships involving the Bureau and the Federal Laboratories in the applied research and development often required for implementation of specific policies in the national interest.

Ninth, Patent and Trademark Office.—The classification, evaluation and protection of invention and technology innovation function of the office makes it reasonable to transfer the Office from the Department of Commerce to the National Policy and Technology Foundation.

Councils.—Superimposed upon the Foundation's structure is a series of independent councils. Council members would be appointed by the Director from outside the Foundation and would include leaders in concerned industry, labor, general consumers and experts from a wide spectrum of society including academia, mass media, finance, government, environmentalists and the professions.

The councils, serving as deliberative public forums for national policy, are the crucial link to the public and the key to the successful function of the Foundation. By serving as an early warning system, offering a comprehensive policy data base and providing policy analysis and assessment, alternative evaluations and area expertise, the Foundation becomes the base from which the councils can work. It is the councils upon their own initiative or in response to requests from the President, Congress or the Directors that would take the lead in investigating and deliberating on long term and basic national policy. The councils would redefine problems, hold public forums, assess alternatives and suggest policy options. It is the councils' voices that would be heard through the policy papers submitted to Congress and the President and which would carry the weight of a "public consensus."

MANAGEMENT OF THE FOUNDATION

The Foundation would have a Director, a Deputy Director and nine Assistant Directors—one for each branch. It would also have a National Policy and Technology Board.

National Policy and Technology Board.—The Board would have 24 members and the Director. Specific responsibilities would include establishing Foundation policy, budget and program review, grant approval and biennial reports to the President for submission to Congress of the important national policy issues, emerging problems and opportunities along with the Foundation's recommendations for such policy legislation as may be deemed appropriate. Members would be Presidential appointees and would be selected from people prominent in a wide variety of fields including the professions, labor, entrepreneurship, management, education, industry, government, technology and trade. To avoid dominance by the Federal Government, the Board would be expected to independently represent all segments of society. Nominations for the Board should be widely solicited including from the Board itself, the national academies, professional societies, business associations, labor associations and other appropriate organizations. Board members would be appointed for 6 year terms. For continuity terms would be staggered.

The intent of the Board along with the councils is to insure that the community of those affected by National Policy will have a say in the operation of the Foundation and the creation of a national consensus for the resulting national policy recommendations.

Director and Assistant Directors.—The Director, the Deputy Director and the nine Assistant Directors of the Foundation would be Presidential appointees at executive levels II, III and IV respectively. The Directors' term of appointment would be 6 years.

In order to permit the strong central operation needed to coordinate activities of the various branches of the Foundation, all authority over the Foundation, other than that reserved to the Board has been given to the Director. The Director may delegate parts of that authority and would be expected to do so, but would always have the ability to take personal control of any aspect of the Foundation operations.

FOUNDATION OPERATIONS—POLICY FACILITATION

Facilitating the creation and where appropriate the implementation of coherent national policy in the long term public interest is the basic need to be satisfied by the National Policy and Technology Foundation.

The National Information Office would collect, organize and disseminate international and national information, data and statistics for public-private policy makers.

The Office of Policy, Analysis and Assessment would continually evaluate data from the National Information Office to identify pending national needs, opportunities or problems. Alternative policy options would be proposed, evaluated and assessed by the Policy Office for consideration by the councils.

Independent public councils utilizing the data, evaluations and assessments of the Policy Office and other sources would respond to requests from the President, Congress, Foundation Directors or upon their own initiative. Councils would provide public forums that openly debate and redefine national policy issues and thus generate the public consensus necessary to avoid legislative gridlock.

With public recognition and acceptance of the equity of the tradeoffs and sacrifices inherent in resolution of any large scale public issue, the Congress and the President would have renewed flexibility to create and legislate consistent integrated national policy in the public interest. Responsibility for the implementation of designated sections of these policies would be assigned by Congress to appropriate agencies. These could include activities which would be brought together in the Foundation from uncertain homes in bureaus scattered throughout the Federal Government.

Advancement of the Nation's civilian technological and professional capabilities would be effected by the Office of National Programs, the Office of the Professions, and the National Bureau of Standards. Emphasis would be upon facilitating policies and programs of substantial national interest where sufficient timely development cannot be expected from the private sector alone due to high risk, long lead time or the sheer magnitude of the required resources.

The Office of Institutional and Human Resource Development would be responsible for technology and professions institutional and human resource development. Stressing public-private cooperation, emphasis would be placed upon the long-term development of human resources and the creation of generic technology useful for many industries.

The United States still leads the world in basic research and technological innovation. However, we too frequently fall behind other nations which have more successfully developed and utilized technology and systems often originated in the United States. Improving technology transfer and deployment in the United States would be an important responsibility of the Office of Small Business, the Office of Intergovernmental Technology and Professional Delivery Systems and the Patent and Trademark Office.

COORDINATION OF PROGRAMS

A separate section of the National Policy and Technology Foundation Act, section 12, requires close coordination of the Foundation's programs with other programs of the Federal Government, with the private sector and with State and local government programs.

A Standing National Foundation Coordinating Board with five members each from the Boards of the National Policy and Technology Foundation, the National Foundation on the Arts and Humanities and the National Science Foundation would be appointed to provide recommendations to improve the collective effectiveness of the three Foundations in the national interest. To the greatest extent feasible, extramural basic research fields which the Foundation wishes to advance should be channeled through the National Science Foundation. Studies in societal value systems and ethics needed to support regulatory cost/benefit analyses would be coordinated with the applied humanities programs of the National Foundation on the Arts and Humanities.

Section 12 also requires that the Policy and Technology Foundation coordinate its small business activities with those of the Small Business Administration. Other coordination is required in other sections of the act. The National Information Office in cooperation with public and private agencies would seek to develop a coherent National Information and Statistics Policy that would lead to the development of readily accessed, comprehensive, computerized National Information and Statistics Data Banks. The Office of Policy, Analysis and Assessment is specifically charged with cooperating and coordinating with other policy bodies of Federal, State and local governments. The Federal Technology and Professions Extension Service is required to coordinate with existing programs such as State Technology Services to avoid duplication or adverse impact. Assistance would be provided to the President's Office of Science and Technology Policy and Analysis.

AUTHORIZATIONS

The act would provide for authorization of activities in fiscal year 1988. Any funds for years beyond 1988 would have to be authorized by future acts. We estimate that the fiscal year 1987 funding for the existing functions proposed to be transferred to the Foundation is about $500 million. We believe that a realistic level of funding for the first full year of operation of the Foundation should be about 20 percent more, or about $600 million. The precise level of authorization would be determined after hearings and a more precise determination of the final makeup of the Foundation.

While $600 million is a substantial expenditure, it represents less than 20 percent of the annual budget of Japan's MITI [Ministry of International Trade and Industry] which is that nation's leading instrument for facilitating national policy. The proposed budget also is substantially less than that of MITI's Agency of Industrial Science and Technology which includes the Japanese equivalent of the U.S. Bureau of Standards.

The success of our trade competitors in coordinating their national policies and advancing their technological competence to secure increased market share can be attributed to their creation and funding of competent national policy instruments.

Summary

The concept of a National Policy and Technology Foundation grows from recognition of the limitations and resulting failures of the present national policy process. There is a clear need to correct the structural shortcomings of national policy institutions that have led to Gramm-Rudman. There is a need to provide the Congress with an effective nonpartisan mechanism for the creation and facilitation of consistent national policy. To satisfy the foregoing need, the Foundation would offer a comprehensive policy data base, policy alternative analyses and assessment, public policy review and consensus and finally—where appropriate—agencies to implement policy and supporting civilian technology.

The National Policy and Technology Foundation would be an independent agency with associated public councils and nine main branches for national information, policy analysis and assessment, national problem focused programs, the professions including engineering, institutional and human resource development, small business, intergovernmental technology and professions delivery systems, the National Bureau of Standards, and the Patent and Trademark Office. The agency would have programs transferred from NSF—almost all of engineering and applied science—and from the Department of Commerce—almost all of the programs of the Assistant Secretary of Commerce for Science and Technology. Responsibility for the centers for industrial technology would reside in the institutional and human resource development branch.

Governance for the Foundation would be handled by a Director and a National Policy and Technology Board patterned in organization but not composition after the National Science Board. Key functions of the Board would be to establish the policies of the Foundation and review the Foundation's budget and programs. The Director would have all powers not assigned to the Board and would be assisted by a deputy and nine assistants, one for each branch.

The bill contains authorization for fiscal year 1986 of $660 million with a line item for each of the nine branches. Additional authorizations will be required for succeeding years. It is expected that the economics to be realized from the Foundation will more than make up for the appropriations required above that presently budgeted for the existing agencies and activities that will be incorporated into the Foundation.

The bill requires close cooperation between the National Policy and Technology Foundation, the agencies and the private sector. A national Foundation Coordinating Board with equal membership from the Boards of the three National Foundations—Policy and Technology, Science, and Arts and Humanities, shall provide recommendations to improve the collective effectiveness of the three Foundations in the national interest.

Mr. **Brown**. Dr. Rosenstein, I know of no one over the years who has made a larger contribution to the understanding by members of Congress to the complexity of the competitiveness issue, and I don't want you to perceive my interrupting you as a reflection on that. I just—we have to recognize that we have a schedule to keep here.

Mr. Winkelman.

Mr. **Winkelman**. Thank you, Mr. Chairman.

Mr. Chairman, members of the subcommittee, my name is Stanley J. Winkelman. I am the principal of Stanley Winkleman Associates. I have been providing consulting services on strategic planning and marketing since my retirement as chairman of Winkleman Stores, Incorporated, about three years ago. Winkelman was, during most of my career, was a publicly-held chain which operated in 1984 100 ladies fashion retail specialty stores in Michigan, Ohio, and Illinois, with sales of about $100 million, and more than 2000 employees.

As I have pointed out in my written statement, my experience in the new Detroit Urban Coalition, formed at the time of the riots in Detroit in 1967, as a charter member then and as its chairman in 1971, is pertinent to this testimony. Also pertinent is my experience with the Metropolitan Affairs Corporation, an urban research organization in southeast Michigan, funded by the private sector to provide a meaningful connection with the public sector to develop regional solutions to regional problems. I became president emeritus of this organization last year, after serving as its president for seven years.

All of my experience causes me to appear before you today in strong support of the proposal for the establishment of a national policy and technology foundation. My friend, Dr. Rosenstein, has expressed the entire picture much better than I can do, and I have tried to provide my perspective in the written statement. And while that statement, submitted last week, addresses the reasons for my support, I believe that the "Dear Colleague" letter of March 24th signed by you, Representative Brown, Claudine Schneider and Richard Gephardt, establishes the critical need for a forum to develop national policy. National policy proposals, as well as a Department of Science and Technology, to promote technical innovation, technology utilization, and the necessary supply of technological manpower.

Had the foundation and the Department of Science and Technology existed at the time of the problems that developed in the auto industry with respect to auto safety and with respect to the gasoline crisis when the price of oil went up, I suspect the result would have been arrived at much more quickly, more efficiently, and we would have saved money in the process.

Actually, our responses to these matters was very slow and very inefficient.

Now the findings noted in Section 2 of the proposed legislation, along with the previous successes with respect to the National Science Foundation and the Agriculture Extension System, also noted in Section 2, clearly established the perspective, the imperative need and the direction.

According to figures prepared by economists Gary Hufbauer and Howard Rosen, and cited in the May 8th issue of Fortune magazine, in an article entitled "Protectionism Can't Protect Jobs," the United States is currently spending $50 billion a year to save 750,000 jobs, or roughly $65,000 per job saved.

I submit that this leaves a tremendous opportunity for saving over the long run if we make a relatively small investment in the National Policy and Technology Foundation.

And consider for a moment the very bad joke of this garbage scow that's running around the Gulf of Mexico looking for a port with a load of garbage being shipped from Long Island. Does that make you feel proud of our role in handling a very critical problem, which has been pushed off to the cities and states, and cannot be solved at that level?

How are problems of our infrastructure going to be solved, how are problems such as waste disposal, hazardous waste disposal, toxic waste disposal going to be handled, if not by some national effort?

As one who has been doing some consulting work in the Eastern Caribbean with respect to a U.S. AID—in conjunction with USAID as part of a contract in that area, it's kind of a joke that this garbage scow may wind up up in Belize, which certainly isn't going to help our efforts to develop industry there.

I have been personally involved in this one. So that the situation is clear—and what I'd like to do, with your permission, Mr. Chairman, is to put in—attach two pieces to my statement. One is the roster of leaders, both Democrat, Republic, labor, business and government, who do make up the Metropolitan Affairs Corporation in Detroit. Some of the names you will recognize. And I would also like to submit—this just came across my desk the other day, and this is the program of Interstoff, the semiannual textile exhibition that takes place in Frankfurt, Germany twice a year. It's the biggest in the world and I think you will be ashamed, as I am, by the attendance of textile makers from the United States.

Mr. Brown. Without objection, that will be made a part of your statement.

Mr. Winkelman. Thank you, Mr. Chairman.

As I conclude this oral presentation, I'd like to provide you with the attachments as I have already done. But, again, Mr. Chairman, I thank you and the subcommittee for the opportunity and the privilege of appearing before you today in support of the National Policy and Technology Foundation. I thank you.

Mr. Brown. Thank you very much.

Dr. Drew, you may proceed. The other members will be back shortly.

[The prepared statement of Mr. Winkelman follows:]

STATEMENT OF

Stanley J. Winkelman

Principal of Stanley Winkelman Associates
Management Consultant
Strategic Planning and Marketing
Retired Chairman of Winkelman Stores, Inc.

regarding the establishment of

A National Policy and Technology Foundation

before the

Subcommittee on Science, Research and Technology
of the Committee on Science and Technology

United States House of Representatives

April 29, 1987

Statement
regarding the establishemnt of
A National Policy and Technology Foundation
Stanley J. Winkelman
April 29, 1987

My name is Stanley J. Winkelman. I am the principal of Stanley Winkelman Associates, a management consultant for strategic planning and marketing, working out of Detroit, Michigan. My primary experience over the years has been my leadership role in Winkelman Stores, Inc., a publicly held chain of 100 ladies fashion specialty stores located in Michigan, Ohio and Illinois, with about 2,500 employees.

While an officer of the company, as General Merchandise Manager, President, and for 11 years, as Chairman and CEO, I have been involved in the evaluation of merchandise, product development and contracting for merchandise that is manufactured in the United States, Western Europe, and in the Orient. In addition, I have worked for almost 40 years in helping to resolve some of the difficult social problems we have faced in Detroit and southeast Michigan.

I have served as a Board Member of New Detroit from the time of its creation in 1967,following the riots. I was its Chairman in 1971.

More recently, as a consultant I have done some work in the Eastern Caribbean as part of a contract with the US Agency for International Development, to help develop labor intensive industry in these neighboring countries that have a high unemployment rate. The economic stability of the area is important to the interests of the United States.

From my earliest visits to european countries in the late 1950's, I was impressed with the organization presentation and accessibility to merchandise that had potential for sale in our stores. These factors contrasted sharply with the impression of the United States presentations at various trade shows which I visited. It was as though the United States was telling the world, "if you want to know about the merchandise that's available from the United States, we will give you a room full of catalogues and dare you to find the information for which you might be looking. By contrast, most countries had relatively elaborate and effective presentations.

While we have made progress since those days, we still lack the sophistication and determination of Western European countries, to say nothing of Japan, Korea, Taiwan and Hong Kong, in our efforts to sell apparel through trade fairs overseas. At the same time, we ring our hands and deplore the state of our exports in relation to our trade deficit. This is true not only for apparel, but for hard goods as well.

The interdependence of the countries of the world seems automatic to most people, and yet we have difficulty facing up to the implications of this fundamental truth in the new intensely competitive environment in which we find ourselves.

The textile industry, with which I am most familiar, has cried for years for protection against import competition. At the same time, while there has been some modernization, the same textile producers are asking for additional protection. They have failed to change their production methods so that they can produce relatively short runs of fashion fabrics, which are required in the apparel trade. Textile producers in other countries have that capability, as a result of their modernization programs. Yet, we appear to be unable to meet the challenge. In this context, protection works against the modernization of the industry, because it protects profitability and makes creative thinking and investment in the future less important.

I recite my own experience in relation to the textile industry by way of providing a frame of reference for my support for the National Policy and Technology Foundation. The Foundation will provide a vehicle for the development of national policy recommendations with the involvement of labor, with the involvement of management, with the involvement of educators, and with the involvement of government. In the proposed legislation it is suggested that this mechanism be funded as a private science and technology foundation.

In the United States, we still find a reluctance for business leaders to work cooperatively with labor and with government, based on old rivalries and theories with respect to the operation of our free enterprise system. We also find government reluctant to condone cooperation between businesses to solve problems such as pollution, auto safety, toxic waste, etc.

The issue is not whether it is desirable for business, education, labor and government to work together. Rather, the issue is how we are going to encourage the cooperative efforts that are required.

There is, as one example, the absolute necessity of developing long term policies that will make us more competitive.

This has been emphasized over and over again in prior testimony before this Subcommittee on Science, Research and Technology. The need is critical if we are to seize the opportunity to improve our own competitiveness, which has so severely eroded because of the high value of the dollar on the one hand and by the determination of our primary competitors, especially Japan, to have a well-coordinated approach to developing their own industry and improving their own export position, on the other.

Historically, trade barriers have proved to have negative effects on the economy as a whole; not only on the United States economy, but on the world economy. Somehow we must have the vision to look at our industrial spectrum and decide which parts of it are those that we really want to build or to sustain over the long run. Then, we must consider those measures which are appropriate to the particular industry.

It is probable, in this context, that some short term protective measures may be needed, but only with appropriate incentives for industry and a genuine strategy to accomplish our objectives.

We all know that very few shoes are manufactured in the United States today.

We also know that the auto industry is fighting a battle to continue as a major factor within our changing economy.

And now--suddenly we are finding our most modern industry, the production of semi-conductors, is facing a formidable challenge based on strategic decisions made in a coordinated effort by Japan a number of years ago.

While one could argue the merits as to whether formulation of policy recommendations should be developed within the government, I believe there is strong argument for establishing a foundation as outlined in the proposal that is before this Subcommittee.

Central national policy planning is not a desirable or practical direction for the United States. Plans take too long to develop and the dynamics of this competitive world would render them obsolete before they could be implemented.

On the other hand, the government can and does take responsibility for actions in the national interest to encourage certain actions on the part of various segments of our society. It is in this context that the development of policy recommendations for consideration by the executive and legislative branches of the government should be placed in a separate environment. However, it must be done with the involvement of representatives of government, along with those of labor, management, and education.

One of our great failures has been to provide the environment for the practical development and production of products that are the result of our research programs.

Why is it that our own great ideas and inventions are being developed and exploited from an economic point of view, by other nations, while we ourselves stand by as spectators?

I submit it is because we as a society have not given sufficient thought nor provided sufficient emphasis on the ultimate objective. That objective should be to encourage new products to be produced efficiently in the United States. We seem to stop with the idea of pure research and find the practical application of that research to be, if not repugnant, then something that will take care of itself.

Maybe it is because we idealize the scientific pioneers who have produced the great scientific breakthroughs. Or, perhaps it is because we have permitted ourselves to reduce the fields of engineering and applied science to a mundane world, which other nations by contrast have found to be very exciting and rewarding.

In any event, it is important that we break the stalemate and the self-defeating pattern of protectionist devices which will not protect us in the long run. We must, in the national interest, get on with the job of developing a system for coordinated policy formulation and economic development.

We have many problems in the metropolitan area of Detroit which are not unique to Detroit, but which reflect on the efficiency of our whole economic system.

These problems include the weakness and obsolescence of the infrastructure in many areas. There is need for concerted efforts to solve problems of hazardous waste disposal, and toxic waste disposal.

These problems are too big for any one geographic area in itself. We at Metropolitan Affairs Corporation, a non profit corporation in Detroit, funded by the private sector, work with the public sector in developing regional solutions to regional problems. Recently I became President Emeritus, after serving as President of the organization for seven years. The formation of MAC was stimulated by the leaders of the three auto companies and

Walter Reuther, about 20 years ago. Indeed, it has solved a number of problems over the years of a regional character.

MAC has taken a close look, for the first time, at the disposal of hazardous waste. The product of its effort has been much in demand around the country, as well as by Governor Blanchard and his staff, and by corporations within Michigan. Yet, the problem of hazardous waste and toxic waste are national in scope, requiring coordination, stimulation, experimentation and development of new approaches, that are beyond the capacity of one company, one industry, one metropolitan region, or one state. We urgently need a mechanism for solving these problems. This mechanism would be provided by the office of Inter Governmental Technology and Professions Delivery System.

In the past few months we have seen a logical attempt to meet the competition of Japan's micro chip industry with the development of Sematech, a consortium of micro-chip companies working together. This consortium by its very nature must be permitted to function, despite our anti trust laws. The issue with micro-chips is whether the United States can be competitive with Japan and not whether the companies that are a part of the consortium are competitive with each other.

The Sematech development underlines the fact that our national approach is not competitive. It is outmoded. It is inefficient for meeting international competition.

The establishment of Sematech by itself brings together the forces of the particular industry, but leaves out the broader elements of government, labor, and education, which are essential for strategic development and for establishing the environment in which necessary changes will take place. There is no suitable agency available. The result is that Congress appears to be turning toward the defense department, as it has in the past.

At best utilizing the Defense Department will put a military perspective on semi-conductor development and limit its productivity because of the national defense budgeting process. In any event, anti trust exemptions will have to be approved to permit the competing companies to work together.

It's sad that in this age of international competition we are permitting the traditional concepts of competition between businesses in the United States to restrict our thinking. We are being beaten by the competition that has found a more flexible approach to industrial development. Our traditional concepts of competition must be applied on a world wide basis, rather than limited to the boundaries of the United States.

As we look ahead to the mammoth problems that must be resolved in this century above and beyond those of the immediate international competitive problem, it becomes clear that innovative approaches will have to be utilized, or we will fail in our efforts to become more competitive. We will fail in our efforts to improve our educational system. We will fail in our effort to restore our aging infrastructure. We will fail in terms the more serious aspects of waste disposal, especially toxic waste. We will put our future leadership in great jeopardy.

TRADE

PROTECTIONISM CAN'T PROTECT JOBS

At least not without doing much more harm than good. In any case it is not needed. Despite the flood of imports, the U.S. is producing plenty of high-paying new jobs. ■ *by Michael McFadden*

IT IS axiomatic among protectionists that imports are wiping out the best red-blooded, high-paying U.S. manufacturing jobs and leaving the displaced workers to scrounge for a living as hamburger flippers. The protectionists make their case with a mixture of haunting portraiture—idled auto plants, shuttered steel mills, distraught ex-workers—and carefully selected statistics. The only answer, they say, is to get tough with our trading partners.

But is it? While imports have shot up some 50% since 1981, the U.S. has generated 7.6 million new jobs. Far more of them have been high paying than low paying (see table). Meantime, protectionist measures designed to help such industries as textiles, steel, and autos have not kept employment in them from shrinking drastically.

The protectionist point of view enjoys the support of powerful constituencies, including labor unions, whose ranks have thinned in recent years, manufacturers who would rather bleat than fight, and Democrats looking for campaign issues. Missouri Representative Richard Gephardt, a candidate for the 1988 presidential election, is sponsoring an amendment that would require the President to impose trade restrictions on countries that run sizable trade surpluses with the U.S. helped by unfair trade practices.

Powerful constituencies, however, cannot

REPORTER ASSOCIATE *Cynthia Hutton*

Quotas help preserve *the jobs of steelworkers like this Bethlehem employee, but only at an estimated annual cost of $750,000 per job.*

turn myth into fact. Yes, U.S. manufacturing employment has dropped some 9% from its 1979 peak. Visible pockets of pain remain as industry continues to restructure.

Some foreign manufacturers are getting special help from their governments—European steelmakers, for instance, are abetted by direct subsidies, import controls, and production quotas. Others enjoy markedly lower wage rates (though the strengthening yen has now lifted total compensation in Japanese manufacturing practically to U.S. levels). And until recently, the strong dollar penalized U.S. exports. But smokestack America's trade woes are due mainly to such old self-inflicted injuries as bloated payrolls, rigid union work rules, and indifferent management.

The protectionists got a big boost from a study published in December by the Joint Economic Committee. Produced by economists Barry Bluestone of the University of Massachusetts and Bennett Harrison of MIT, the JEC study contended that 58% of the eight million new jobs the U.S. economy created between 1979 and 1984 paid less than $7,000 a year, measured in 1984 dollars. It also made the dramatic assertion that the American middle class is shrinking.

The JEC study poured a few drops of new wine into an old bottle. A small group of economists have been advancing the argument of the disappearing middle class for several years, starting in the early 1980s when recession was playing havoc with employment and income growth. Every such claim has evaporated when put to rigorous examination, and the Bluestone-Harrison thesis is proving no exception.

FOR ONE THING, says Bruce Bartlett, a senior fellow at the Heritage Foundation, a conservative Washington research group, the study erroneously lumps full-time and part-time workers together to create the impression that job growth is occurring only in the low-paid categories. Of the 4.6 million jobs created between 1979 and 1984 that paid less than $7,000 a year, 1.7 million were part time. Excluding part-timers in all categories, Bartlett says, the proportion of low-paying jobs falls sharply, from 58% to 22% of the total. Does the surge of part-time work suggest an inadequacy in the U.S. job-creating mechanism? No, according to economists at the Bureau of Labor Statistics. Last year, for example, about 75% of part-time workers—many of them teenagers and retired people—were seeking part-time jobs.

Economists also fault the time periods used in the JEC study. Bluestone and Harrison compare job growth in 1979, a year when the economy had reached a cyclical peak, with job growth in 1984, when it was still recovering from the brutal 1981-82 recession. Bluestone and Harrison have since updated their figures; the 1985 data, they say, show that 44% of the new jobs since 1979 were in the low-wage category. Nonetheless, an examination of wage distribution among U.S. jobs over the past ten years shows that it is about the same as it was a decade ago.

The ten-year figures, moreover, mask a powerful shift in the kinds of jobs being created these days. Earnings classifications developed in the JEC study, updated in 1986 dollars, define low-paying jobs as those that

PLAINLY MORE.

[illegible] but are costing U.S. [illegible]

pay under $7,300, middle-pay jobs as $7,300 to $29,000, and high-pay as everything above. Using these classifications, high-paying new jobs increased 49% from 1981 to 1985 while low-paying jobs rose 25%; those in the middle increased 31%. As a result, high-paying jobs jumped from 14% of all jobs in 1981 to 16% in 1985. Low-end jobs fell from 33% to 31%, while the middle remained about the same. There is some evidence that the proportion of lower-paying jobs within each wage category has increased. But this trend appears partly due to baby-boomers taking jobs for the first time, and an increasing number of women entering the work force. Wages within each category should rise as the inexperienced workers advance.

Most of the new job growth has come in the service sector, which protectionists characterize as a sinkhole of dead-end jobs. Among the fields of growth: health care, law, and computer services. Pay levels seem likely to keep rising in services. Labor Secretary William Brock warns that the U.S. is heading for a critical shortage of skilled mechanics, teachers, nurses, and paralegals in years to come. At the same time, manufacturing is starting to generate a trickle of new jobs. Latest BLS data show that manufacturing employment rebounded to a seasonally adjusted 19.2 million at the end of last year, up 6.7% from its low of 18 million in December 1982. It is unlikely that the number will soon approach the June 1979 peak of 21.2 million.

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TRADE

number of Japanese cars sold in the U.S. were meant to give Detroit time to become competitive with the Japanese. But in order to compete, U.S. carmakers have shed over 130,000 jobs since 1978, and the process is still not complete.

PROTECTIONISTS argue that the quotas reduced the pain of readjustment by letting automakers earn enough profits to preserve some jobs and help displaced workers find new ones. But quotas can be addictive, allowing industries to put off hard choices they must make to become fully competitive. Despite the soaring yen, which has driven up the prices of Japanese autos in the U.S. by some 10% so far, Detroit still insists it needs protection. In January, Japan agreed to extend restraints for a seventh year.

A long history of protection has not kept the textile industry from losing jobs either. In the decade after the U.S. signed a multilateral restraint agreement in 1962, employment in the textile and apparel industry rose 9%. But the aggregate figures hid massive job losses in the Northeast as textile manufacturers reduced labor costs by moving south and west. Between 1960 and 1970, textile employment in New England declined 34%, while increasing 19% in the South. Then between 1973 and 1984, as the industry increasingly automated, total employment fell 28% to 722,000—30% below its 1961 level.

If Congress does pass protectionist legislation, the U.S. should expect its trading partners to pay it back in kind. Using 1984 data, Lester Davis, an economist specializing in international trade at the Commerce Department, estimates that every $1 billion of exports the U.S. generates supports 25,800 jobs. Overall, he calculates, 5.5 million Americans hold jobs that are linked to exports.

How many of those jobs would go in a trade war? It's hard to say, but it is instructive to remember that the infamous Smoot-Hawley Act, which effectively closed U.S. markets to imports, helped bring on the Great Depression. As the world economy slumped and America's trading partners retaliated, U.S. exports shrank from 6% of GNP in 1930 to 4.3% in 1933. An estimated one million workers in export-related industries lost their jobs. The price of severe protection today could be a world recession and possibly another depression. Either would cost more jobs than the protectionists can ever dream of saving. ◘

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A REGIONAL PERSPECTIV AND MISSION

Metropolitan Affairs Corporation (MAC) links the private and public sectors in common efforts to confront critical areawide public policy issues facing metropolitan Detroit.

A coalition of business, labor and government leadership with a region-wide perspective, MAC provides a unique opportunity for constructively addressing those urgent problems and concerns in greater Detroit that respect no jurisdictional boundaries; concerns that, if left unattended, would threaten the region's social and economic vitality.

Effectively addressing complex urban/regional problems requires a cooperative partnership using both private and public resources. MAC distinctively matches that problem scale—the region—with busin , labor and government leadership that co -tively has the vision and capacity for stimulating needed action.

MAC is headquartered at
814 Book Building
Detroit, MI 48226; 961-2270

Executive Director: John M. Amberger
Manager: B. David Sanders

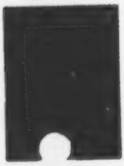
WHAT THEY SAY ABOUT METROPOLITAN AFFAIRS CORPORATION

"MAC offers an opportunity where the public sector and the private sector can come together and identify and then work jointly on solution of urgent issues facing this region."

Robert C. Larson
President
The Taubman Company, Inc.

"We don't just prepare reports or suggestions and throw them over the wall, hoping that they'll take. We are carefully involved in the handoff of each project to make sure that something happens because of it."

Richard L. Measelle
Managing Partner
Arthur Andersen & Co.



"By joining together (in the MAC Joint Ventures Project) and ending up with a net savings to each of the communities, it is encouragement to do other things, perhaps even without the assistance of MAC."

Edward H. McNamara
Wayne County Executive
and Former Mayor of Livonia

DEMOCRAT

"Metropolitan Affairs Corporation serves us so very well, to make sure that our points of view can be articulated. That's the great genius of Metropolitan Affairs Corporation."

Marc Stepp
Vice President
International Union—UAW

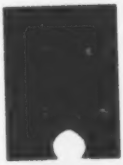
DEMOCRAT

"I see the Metropolitan Affairs Corporation as being an excellent vehicle for effecting change in government."

Nancy J. White
President
League of Women Voters of Michigan

"We've had a lot of problems to solve around here. It became clear that we either did them as a merged group of people who were all aiming in the same direction or we weren't going to get them done. MAC has been a very big help in that."

Walter J. McCarthy, Jr.
Chairman of the Board &
Chief Executive Officer
Detroit Edison



"You have to be involved to see how it works, and I know it works, and I know that MAC helps make it work."

Daniel T. Murphy
Oakland County Executive

REPUBLICAN

"There is an efficiency level to this, so that it is really fair to say that every dollar is well spent...it is a good investment in our community"

Alan E. Schwartz
Senior Partner
Honigman, Miller, Schwartz and Cohn

REPUBLICAN

Those are comments of Directors and project participants that are featured in a short video presentation on Metropolitan Affairs Corporation. That video, "A Distinctive Mission", is available either by calling 961-2270 or by returning the enclosed request form.

A PROBLEM-CONFRONTING PROCESS

Using the coalition resources available in its business, labor and government partnership, Metropolitan Affairs Corporation employs a multi-faceted process:

- Identifying key issues or concerns where MAC can make a difference—and where no other organization is playing an effective role;
- Convening those individuals likely to be responsive to—or, have a stake in—the issue;
- Focusing on the true nature or critical aspect of the issue;
- Researching possible options or courses of action;
- Stimulating informed dialogue or debate;
- Building consensus on "best" solution options;
- Taking direct action, if necessary, to implement proposed solutions;
- Transferring continuing initiatives to affected institutions where possible and appropriate;
- Brokering additional resources that may be needed; and,
- Maintaining focus on the options to insure that conclusive action is finally taken.

Through this process, MAC maintains an active catalytic role as a broker of those ideas, approaches and initiatives that make greater Detroit a better place to live and work.

OFFICERS

ROBERT C. LARSON, PRESIDENT
RICHARD L. MEASELLE, VICE PRESIDENT-BUSINESS
ROBERT E. SMITH, VICE PRESIDENT-GOVERNMENT
MARC STEPP [illegible] PRESIDENT-L[illegible]
ROBERT R. RE[illegible], SECRETARY
HARRY KALAJIAN, TREASURER

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DAVID ADAMANY
JAMES A. ALIBER
CHARLES A. ALLEN
ROBERT KEITH ARCHER
CHARLES F. BROWN
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DAVID V. VAN HOWE
GERALD E. WARREN
JAMES R. WATERSTON
NANCY J. WHITE
STANLEY J. WINKELMAN*
COLEMAN A. YOUNG

*President Emeritus

metropolitan affairs corporation

1986 INVESTORS

ARA SERVICES, INC.
ALLIED AUTOMOTIVE
AMERICAN NATURAL RESOURCES CO.
ANTON'S GENTLEMEN'S APPAREL
ARTHUR ANDERSEN & CO.
AUTOMOBILE CLUB OF MICHIGAN
BATTEN, BARTON, DURSTINE & OSBORN, INC.
BLUE CROSS AND BLUE SHIELD OF MICHIGAN
BORG-WARNER CORPORATION
BOVITZ & CO., CPA, P.C.
BOZELL, JACOBS, KENYON & ECKHARDT
BUNDY FOUNDATION
CHAMPION SPARK PLUG COMPANY
CHRYSLER CORPORATION FUND
COMERICA
CONSUMERS POWER COMPANY
CORE INDUSTRIES
CROWLEY, MILNER & CO.
DELOITTE, HASKINS & SELLS
DETROIT EDISON
DETROIT FREE PRESS
DETROIT NEWS
DICKINSON, WRIGHT, MOON, VAN DUSEN & FREEMAN
ERNST & WHINNEY
EX-CELL-O CORPORATION FOUNDATION
FEDERAL-MOGUL CORPORATION
FIRST FEDERAL OF MICHIGAN
MAX M. FISHER
FOR[illegible]TOR COMPANY [illegible]D
FRU[illegible] CORPORATI[illegible]ARITABLE FUND
GENERAL MOTORS FOUNDATION, INC.
FRANK B. HALL & CO. OF MICHIGAN
HANDLEMAN COMPANY
MORTEN E. HARRIS
HONIGMAN, MILLER, SCHWARTZ & COHN
HUDSON'S
HUDSON-WEBBER FOUNDATION
INTERNATIONAL UNION—UAW
JACOBSON STORES, INC.
KMART CORPORATION
EDWARD C. LEVY CO.
LEWIS, WHITE & CLAY, P.C.
LUDINGTON NEWS COMPANY
MARSH & MC LENNAN
MASCO CORPORATION
FREDERICK C. MATTHAEI, JR.
MICHIGAN BELL
MICHIGAN CONSOLIDATED GAS COMPANY
MICHIGAN MUTUAL INSURANCE COMPANY
MILLER, CANFIELD, PADDOCK & STONE
MONSANTO FUND
C.A. MUER CORPORATION
NATIONAL BANK OF DETROIT
PR ASSOCIATES, INC.
PEAT, MARWICK, MITCHELL & CO.
PERRY DRUG STORES CHARITABLE FUND
PLANTE & MORAN
PRICE WATERHOUSE & COMPANY
R.P. SCHERER CORPORATION
SEALED POWER FOUNDATION
SEARS, ROEBUCK AND CO.
SIMS-VARNER & ASSOCIATES
STANDARD FEDERAL SAVINGS & LOAN
STROH BREWERY COMPANY
THE TAUBMAN COMPANY, INC.
TRW STEERING & SUSPENSION DIVISION
TOUCHE ROSS & CO.
UNISYS
UNITED TECHNOLOGIES AUTOMOTIVE
WDIV/TV 4
WINEMAN INVESTMENT CO.
STANLEY WINKELMAN ASSOCIATES
WINKELMAN STORES, INCORPORATED
WRIGHT MUTUAL INSURANCE CO.

A RECORD OF ACCOMPLISHMENT

Metropolitan Affairs Corporation has:

- Produced an acclaimed report on venture capital financing, a report used by the Economic Alliance for Michigan in suggesting a new framework for increasing reinvestment in Michigan.

- Initiated joint measures for containing health care costs for 13 communities in Oakland County, saving several hundred thousand dollars annually.

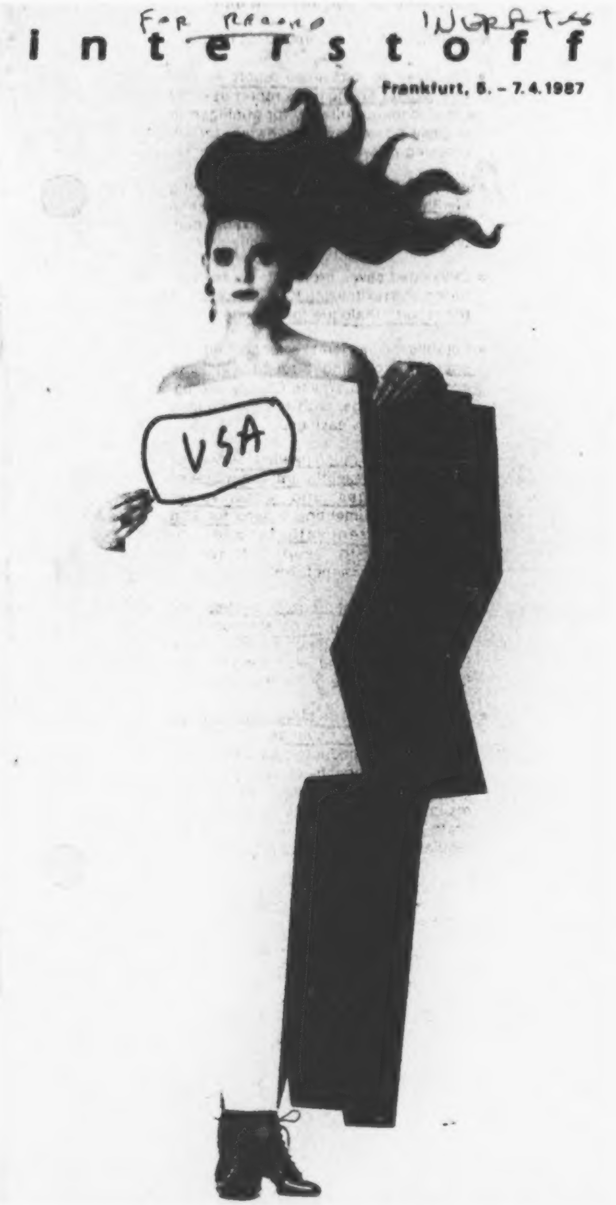
- Developed seven proposals for restructuring and revitalizing K-12 education in the report "Dialogue for Change".

- Established a joint arrangement for shared purchasing through which 16 communities in Wayne County averaged 20% savings, with one community realizing a 60% savings.

- Conducted a much-needed survey of the region's essential infrastructure of roads, bridges and water/sewer systems, documenting a need for $2.6 billion in renovations and improvements to keep the region economically competitive.

- Created a computerized system for jointly handling public safety records in six adjoining cities, saving some $95,000 initially and expediting law enforcement and fire protection services.

- Prepared a report on siting of hazardous waste disposal facilities, identifying major adverse economic as well as environmental impacts of failing to site such essential facilities. The report's recommendations are being used by the State of Michigan to revamp current regulations for the siting process.



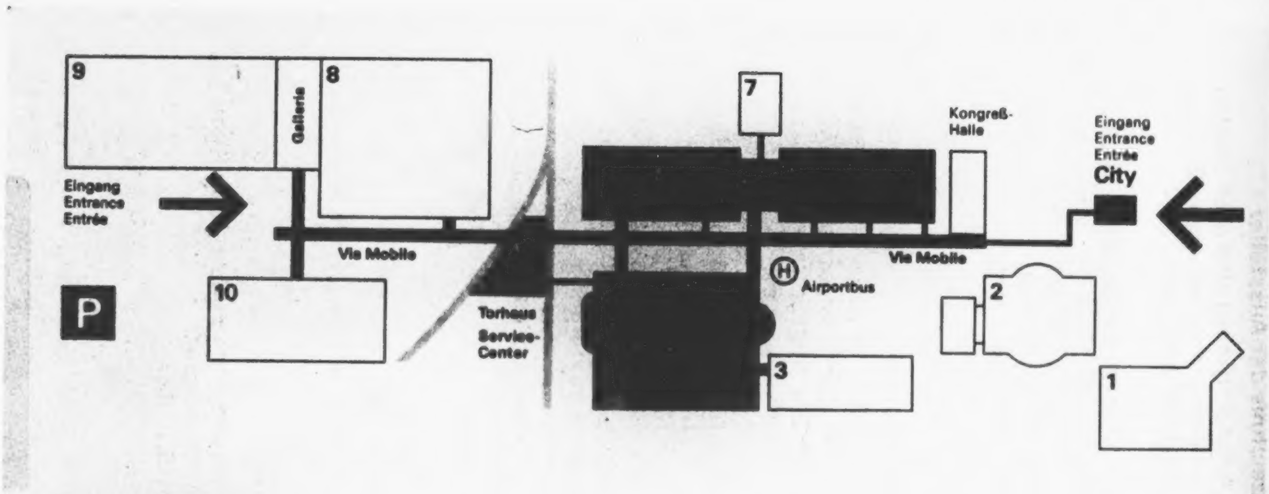
For Record INGRATIS

Interstoff

Frankfurt, 5. – 7.4.1987

USA

Verzeichnis der Aussteller · List of exhibitors
Liste des exposants · Elenco degli espositori


9
Galleria
8
7
Kongreß-Halle
Eingang
Entrance
Entrée
City
Eingang
Entrance
Entrée
Via Mobile
Via Mobile
P
10
Torhaus
Service-Center
H
Airportbus
2
3
1

Interstoff
Frankfurt

Internat[illegible]le Fachmesse
für Bek[illegible]ngstextilien

International Trade Fair
for Clothing Textiles

Salon International
des Textiles d'Habillement

Salor[illegible]ternazionale
dei T[illegible] d'Abbigliamento

Verzeichnis der Aussteller

Die Ausstellerfirmen sind nach Staaten geordnet und innerhalb dieser Gruppen alphabetisch aufgeführt.

In diesem Verzeichnis sind lediglich die Anschriften der Aussteller und Angebotshinweise in Kurzfassung aufgeführt.
Die vollständigen Angaben finden Sie im offiziellen Messekatalog.

Produktgruppen

Die neben den Adressen in der Tabelle stehenden Punkte weisen auf die Produktgruppen bzw. Angebotsbereiche der Ausstellerfirmen hin:

1 Stoffe für Damenbekleidung
2 Stoffe für Herrenbekleidung
3 Stoffe für Kinderbekleidung
4 Futter- und Einlagestoffe
5 Spezialartikel
6 Zubehör
7 Fasern und Garne
8 Fachpublikationen/Verlage
9 Designer

Alle Angaben ohne Gewähr für die Richtigkeit und Vollständigkeit.
Stand: 5. 2. 1987

List of exhibitors

All exhibitors shown in this list are grouped according to countries of origin and arranged alphabetically.

All addresses of firms and references to products stated in this list are only given in abridged form. Complete addresses and data are to be found in the official fair catalogue.

Product Groups

The numbers stated next to the addresses refer to the individual exhibitor's group or range of products:

1 Fabrics for Ladies' Wear
2 Fabrics for Men's Wear
3 Fabrics for Children's Wear
4 Linings and Interlinings
5 Special Articles
6 Accessories
7 Fibres and Yarns
8 Trade Publications/
Publishing Houses
9 Designers

No responsibility is taken for the accuracy of this information and data.
Position as of: 5. 2. 1987

Liste des exposants

Les exposants sont groupés par pays et classés alphabétiquement à l'intérieur de chaque groupe.

Cette liste ne comporte que des indications abrégées sur les adresses des exposants et leurs secteurs d'activité. Vous trouvez des indications détaillées dans le catalogue officiel de l'exposition.

Groupes de produits

Les points figurant dans le tableau, en face des adresses, correspondent aux groupes de produits resp. aux secteurs d'activité:

1. Tissus pour l'habillement de la femme
2. Tissus pour l'habillement de l'homme
3. Tissus pour l'habillement de l'enfant
4. Doublures et triplures
5. Articles spéciaux
6. Accessoires
7. Fils et fibres
8. Publications spécialisées, maisons d'édition
9. Dessinateurs

Nous ne garantissons ni l'exactitude ni l'intégralité de ces indications.
En date du: 5. 2. 1987

Elenco degli espositori

Le ditte espositrici sono ordinate per paese ed elencate in ordine alfabetico nell'ambito di questi gruppi.

In questo elenco figurano solamente gli indirizzi degli espositori e brevi accenni all'offerta. I dati completi sono reperibili nel catalogo ufficiale della fiera.

Gruppi di prodotti

I punti che si trovano sulla tabella vicino agli indirizzi indicano i gruppi di prodotti ed i campi di offerta delle ditte espositrici:

1 stoffe per l'abbigliamento femminile
2 stoffe per l'abbigliamento maschile
3 stoffe per l'abbigliamento per bambini
4 fodere e materiali per imbottiture
5 articoli speciali
6 accessori
7 fibre tessili e filati
8 pubblicazioni specifiche/case editrici
9 disegnatori

I dati si intendono senza responsabilità quanto l'esattezza e la completezza.
Situazione al: 5. 2. 1987

製品区分

一覧表で、出展企業住所の横に記載されている数字は、
製品区分または出展区分を表示しています。

1　婦人服地

2　紳士服地

3　子供服地

4　裏地、しん、パッド

5　特殊専門品目

6　小物

7　糸類

8　業界専門出版物、出版社

9　デザイナー

دليل العارضين

ترشتوف

دليل العارضين

الشركات العارضة منظمة وفقا للدول التابعة لها ومدونة فى هذه القائمة وفقا للحروف الابجدية.

فى هذا السجل يوجد فقط موجز عن عناوين العارضين ، وارشادات خاصة بالعرض . الشرح الكامل للعرض تجدونه بالتفصيل فى كتالوج المعرض الرسمى.

مجموعات الانتاج

النقط الموجودة فى الجدول بجوار العناوين تشير الى مجموعات الانتاج او بالمعنى الاصح تشير الى مجال المعروضات للشركات العارضة :

١ اقمشة خاصة لملابس السيدات
٢ اقمشة خاصة لملابس الرجال
٣ اقمشة خاصة لملابس الاطفال
٤ اقمشة الحشو والبطانه
٥ اصناف خاصه
٦ مستلزمات الاقمشه
٧ خيوط ومغزولات
٨ قسم عام للتخصص / النشر
٩ مصمم

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Amerika, Vereinigte Staaten von — United States — Etats-Unis — [illegible] Uniti アメリカ合衆国 امريكا									
Arrow Fabrics 1265 Broadway, USA-New York N.Y. 10001									
Avondale Mills 1430 Broadway, New York N.Y. 10018	●	●	●				●		
C & C Metal Products 456 Nordhoff Place, Englewood, New Jersey 07631									
Cranston Print Works USA Co. 1412 Broadway, New York 10018	●	●	●						
Hi-Fashion Fabrics Inc. 483 Broadway, USA-New York, N.Y.									
Integrity Textiles 2460 Coral Street, Philadelphia, PA. 19125									
Midori Textiles Inc. 1359 Broadway, USA-New York, N.Y. 10018									
PDT USA Ltd. 1450 Broadway, New York, N.Y. 10018	●	●	●						
Quality Braid International 34-20, 45th Street, Long Island City, N.Y. 11101									
Amy Wiest 7th East 12th St., USA-New York, N.Y. 10003									
Australien — Australia — Australie オーストラリア استراليا									
John Kaldor Fabricmaker Pty. Ltd. 255 Riley Street, Surry Hills 2010 NSW	●	●							
Belgien — Belgium — Belgique Belgio ベルギー بلجيكا									
Belgozim Pvba. P. Vanderscheltenstraat 37, B-9700 Oudenaarde									
Celanese S.A. 251, Avenue Louise, B-1050 Bruxelles									

Produktgruppen/ProductGroups/GroupesdeMerchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Colin-Desreumaux S.A. Rue Bara, 8, B-1070 Bruxelles									
Concordia, N.V. Industriezone E 3, B-8790 Waregem	●			●					
Cotesa-Devos N.V., Fabriekstraat, B-8790 Waregem	●	●	●	●	●				
N.V. Deerlijkse, Waregemstraat 29, B-8740 Deerlijk	●	●	●						
Fashion Fashion — EEG International Linen Promotion Charles Lemairestr. 1, B-1160 Brüssel									
Febeltex VZW Montoyerstraat 24, B-1040 Bruxelles									
A. Gevaert & Co. N.V., Gevaco Lindestraat 58, B-9700 Oudenaarde	●	●	●		●				
Gevaert Bandweverij, N.V. Markt 35, B-9800 Deinze						●			
Goeters N.V. Ars et Labor Herderstraat 4, B-9140 Zele									
International Institute for Cotton, 10 Rue du Commerce, B-1040 Brüssel							●		
S.A. Meunier Frères Mont 63, B-7890 Ellezelles									
U.T.O. Oudenaardse Textilfabrieken N.V. Dijkstraat 47, B-9700 Oudenaarde	●								
Pennel et Flipo S.A. Rue des Tilleuls, B-7750 Warcoing	●		●						
Seyntex N.V. Seyntexlaan 1, B-8880 Tielt									
N.V. SOFINAL S.A. Postbus 32, B-8790 Waregem	●	●	●	●					
Textilia Industries Oostmoer 2, B-9950 Waarschoot									
Tyber N.V. Iepersestraat 311, B-8600 Menen									
U. C. O. S.A., N.V. Bellevue 1, B-9218 Gent	●	●	●	●			●		
UTEXBEL S.A. 30, Avenue César Snoeck-Laan, B-9600 Ronse	●	●	●						
UTO — VEW Dijkstraat 47, B-9700 Oudenaarde									
VEW-Verenigde Eeklose Weverijen N.V. Gebr. von de Woestijneplein 12, B-9900 Eeklo									
P. Wittamer - Henrist, Sprl. Tissages, 29, Blvd. des Fusillés, B-9600 Renaix	●	●	●						
Wollux Sprl B.P. 60, B-7700 Mouscron	●								
N.V. Tricotagewerk Wydooghe Ambachtenstraat 60, B-8700 Izegem			●						

Produktgruppen/Product Groups/Groupes de Merchandises	1	2	3	4	5	6	7	8	9
製品区分 مجموعة الدول المنتجه	١	٢	٣	٤	٥	٦	٧	٨	٩
Brasilien — Brazil — Brésil — Brasile ブラジル البرازيل									
São Paulo Alpargatas S.A. Postfach 8001, BR-São Paulo	●	●							
Corduroy S.A. Industrias Texteis P.O. Box 6905, BR-São Paulo									
Lanificio Record S.A. Rua Sapucaia 1052/76, BR-03170 São Paulo									
Santista Textiles Av. Maria Coelho Aguiar 215 BR-05804 Jardim São Luis/S. Paulo									
Bulgarien — Bulgaria — Bulgare ブルガリア بلغاريا									
Aho Industrialimport Positanostr. 3, BG-1040 Sofia	●								
China — China — Chine — Cina 中国 الصين									
China National Textiles Imp. & Exp. Corp. 82 Dong An Men Street, Beijing, VR China									
China Silk Corporation 82, Dong An Men Street, Beijing, China				●	●	●			
Exportskooporation des Ministeriums für Textilindustrie Dong Chang An Str. 12, Beijing, VR China									●

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Dänemark – Denmark – Danemark – Danimarca デンマーク الدينمارك									
Dansk Transfertryk A/S Marsvej 7–9, DK-7430 Ikast	●	●							
Ikast Stofvaeveri A/S, Marsvej 7–9, DK-7430 Ikast	●	●	●						
Nordisk Textil Vaeveri og Trykkeri A/S Rugaardsvej 103–115, DK-5100 Odense C									
Novotex Ikast A/S Ellehammervej 8, DK-7430 Ikast	●	●	●						
A/S Scanlace Farvervej 1, DK-8800 Viborg									
Sunds Rundvaeveri A/S Navervej 3–5, DK-7451 Sunds									
B. W. Wernerfelt A/S Vandtaarnsvej 83, DK-2860 Soeborg	●	●	●						
Deutsche Demokratische Republik German Democratic Republic République Democratique Allemande Repubblica Democratica Tedesca ドイツ民主共和国 المانيا الديمقراطيه									
AHB Textil-Commerz Unter den Linden 62–68, DDR-1080 Berlin	●	●	●	●					

Produktgruppen/Product Groups/Groupes de Merchandises	1	2	3	4	5	6	7	8	9
製品区分 مجموعة الدول المنتجه	١	٢	٣	٤	٥	٦	٧	٨	٩
Deutschland, Bundesrepublik und Berlin (West) — Federal Republic of [illegible]many — République fédérale [illegible]emagne — Repubblica Federale di Germania ドイツ連邦共和国（西ベルリンを含む） المانيا الغربيه وبرلين (الغربيه)									
A-Quer, Atelier für Textildesign Luisenstr. 45, 4150 Krefeld 1									●
Achter & Ebels GmbH & Co. KG Postfach 685, 4050 Mönchengladbach	●	●			●				
J. F. Adolff Aktiengesellschaft Postfach 11 09, 7150 Backnang							●		
Adolff-Garn-Export GmbH, Postfach 11 23, 7150 Backnang							●		
Allfratex Vertriebs GmbH Postfach 131, 8750 Aschaffenburg									
Andreae, Christoph GmbH Grüner Dyk 28, 4150 Krefeld	●	●	●						
Anvertex Konstantinstr. 58, 4050 Mönchengladbach									
Asahi Chemical Industry (Deutschland) GmbH Lyoner Str. 44—48, 6000 Frankfurt/M. 71									
Astor-Werk Markgrafenstr. 6, 5830 Schwelm									
C. Aufermann + Söhne GmbH + Co., Postfach 11 43, 5880 Lüdenscheid						●			
Dr. K. Baldauf GmbH & Co. KG Stuttgarter Str. 2—8, 7434 Riederich						●			
J.L. de Ball Vertriebsges.mbH Postfach 12 61, 4054 Nettetal 1									
[illegible]ls-Feldhoff GmbH & Co., [illegible]ch 20 01 38, 5600 Wuppertal 2						●			
Bartl, Kurt, GmbH, 8541 Röttenbach									
Bartl, Heinrich, GmbH & Co., Spitzen- und Stickereifabrik, Postfach 11 47, 7980 Ravensburg	●		●			●			
Baumwollspinnerei Gronau AG Postfach 11 49, 4432 Gronau									
Bayer AG 5090 Leverkusen-Bayerwerk									
Beiersmann, Ewald & Sohn KG, Postfach 22 03 84, 5600 Wuppertal 22	●	●	●			●			
Berning & Söhne GmbH & Co., Otto-Hahn-Str. 57, 5600 Wuppertal 21						●			
Bertsche, Edwin, Stickerei-Motive, Postfach 12 28, 6238 Hofheim/Taunus						●			
Webotex W. Bodenschatz KG, Postfach 61, 8651 Presseck	●		●	●	●				
Bödicker, Karl, GmbH Postfach 15 03 20, 4600 Dortmund 15						●			

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Julius Boos jr. GmbH & Co. KG Postfach 25 01 40, 5600 Wuppertal 2									
Bornemann & Bick KG, B&B-Etiketten Postfach 20 65, 4322 Sprockhövel 2									
Brennet AG, Postfach 13 50, 7880 Bad Säckingen	●	●					●		
Brinkhaus, H., GmbH & Co. KG Postfach 11 01 65, 4410 Warendorf 1									
BSB Spitzen- u. Besatz-GmbH & Co. KG Postfach 24 01 80, 5600 Wuppertal 2								●	
Buddeberg & Weck GmbH Plüschowstr. 5 – 7, 5600 Wuppertal 2									
August Bünger Bob-Textilwerk KG GmbH & Co. Postfach 24 01 80, 5600 Wuppertal 2									
Wilhelm Büsgen GmbH & Co. KG Postfach 20 02 05, 5600 Wuppertal 2						●			
Buntweberei Crone GmbH & Co. Borkener Str. 63 – 67, 4420 Coesfeld	●								
Calwer Decken- und Tuchfabriken AG, Postfach 1161, 7260 Calw/Württbg.	●	●	●	●	●				
Cewe Textildruck GmbH Bendheckerstr. 7, 4050 Mönchengladbach 2	●								
Celler Modeknopf GmbH Wernerusstr. 12, 3100 Celle									
Cha-Telle GmbH Postfach 132, 7470 Albstadt 3									
Chanty-Spitzenfabrik GmbH Postfach 1180, 6074 Rödermark-Urberach					●				
Collection Holm GmbH, Postfach 11 40, 4156 Willich-2 Anrath	●				●				
Gebr. Colsman GmbH & Co. Postfach 15 01 52, 4300 Essen 15									
Corvett-Spitzen GmbH & Co. KG Postfach 105, 4927 Lügde b. Bad Pyrmont	●								
Coste Import-Export GmbH Neuer Wall 75, 2000 Hamburg 36									
CreaTeam-Design Kaiserstr. 100, 4150 Krefeld									●
Cremer KG Postfach 52 04 49, 5000 Köln 51						●			
Dechamps Textil GmbH, Postfach 405, 5100 Aachen	●	●							
C.A. Delius & Söhne Postfach 61, 4800 Bielefeld 1									
Dentex-Spitzen GmbH Postfach 11 73, 4933 Blomberg					●	●			
Dessins Studio „H" GmbH Schmelzofenvorstadt 33, 7920 Heidenheim									●
Deutscher Fachverlag GmbH, Postfach 10 06 06, 6000 Frankfurt a. M. 1								●	
Deutsches Institut für Herrenmode Messeplatz 1, 5000 Köln 21									
Dierig, Christian GmbH, Postfach 10 14 69, 8900 Augsburg	●	●	●	●	●				

Produktgruppen/Product Groups/Groupes de Merchandises	1	2	3	4	5	6	7	8	9
製品区分 مجموعة الدول المنتجة	١	٢	٣	٤	٥	٦	٧	٨	٩
M. Dohmen GmbH & Co. KG Virmondstr. 141, 4156 Willich 4							●		
Günter Drews Weg, 7187 Schrozberg									
nsee GmbH, Kurler Str. 256, 4600 Dortmund 14									
Elastic GmbH, Postfach 20, 3579 Neukirchen	●	●	●						
Feinweberei Engels GmbH Postfach 20 04 41, 4050 Mönchengladbach 2	●								
Enka AG, Postfach 10 01 49, 5600 Wuppertal 1							●		
Erba AG, Postfach 15 40, 8520 Erlangen	●	●	●	●			●		
Eschler Textil GmbH Postfach 4106, 7460 Balingen-Frommern	●		●	●					
ETAG Tuchfabrik GmbH, Postfach 5, 4052 Korschenbroich 1		●							
Fashion Guide Verlag Kaiser-Wilh.-Ring 19, 4000 Düsseldorf 11									
Feller & Co. Postfach 1163, 8882 Lauingen/Donau									
Fischer-Fürwentsches GmbH & Co. Textilwerk KG Postfach 11 02 62, 4060 Viersen 11									
Führen, Leo, Postfach 546, 5100 Aachen	●	●							
V. Gierlings GmbH & Co. KG, Postfach 11 03 62, 4060 Viersen 11	●	●	●	●	●				
Girmes-Werke AG, Postfach 11 20, 4155 Grefrath 2-Oedt	●	●	●	●	●				
Girmes AG Postfach 12 61, 4054 Nettetal 1									
Gottschild & Co. Gladbacher Str. 266, 4150 Krefeld 13					●	●			
G. Greeve GmbH Kuhlenstr. 13, 4950 Minden									
, Gebr. GmbH ach 14 05, 7432 Bad Urach 1							●		
Grube, R. W., & Co. GmbH Postfach 12 64 25, 1000 Berlin 12						●			
H. W. Gunther GmbH & Co. Industriestr. 6, 4540 Lengerich/Westf.								●	
Gutos Metallschließenfabrik Bader & Hoch GmbH & Co. KG Postfach 226, 7530 Pforzheim				●	●				
Haru-Kuraray GmbH Robert-Kling-Str. 27, 6336 Solms-Oberbiel									
Heid GmbH Postfach 11 46, 6907 Nußloch						●			
Helsa-Werke Postfach 60, 8586 Gefrees						●			
Hengersberger Posamentenfabrik GmbH, Postfach 40, 8355 Hengersberg						●			
Gisbert Hennessen Verlag GmbH & Co. KG Königsallee 70, 4000 Düsseldorf 1								●	

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Herosé Stoffdrucke u. Textilvertriebs GmbH, Reichenaustr. 11, 7750 Konstanz	●		●						
P. & M. Hillringhaus Westkotter Str. 180a, 5600 Wuppertal-Barmen									
Hinrichssegen Modedruck Postfach 13 29, 8046 Garching									
Hoechst Aktiengesellschaft, Postfach 80 03 20, 6230 Frankfurt/M. 80							●		
Holzhauser Textil-Design Blaubeurer-Str. 88, 7900 Ulm									●
Hoon, Gebr., Postfach 13 40, 4443 Schüttorf	●	●	●						
Robert Hoppe GmbH & Co. Postfach 17 01 47, 5650 Solingen 1					●	●			
Inter-Jersey GmbH & Co. KG Postfach 240, 7453 Burladingen	●	●							
Internationales Wollsekretariat Postfach 44 09, 4000 Düsseldorf 1	●	●					●		
Irmen, Peter GmbH & Co. KG Postfach 120, 4052 Korschenbroich 1		●							
Jansen, Leo, Postfach 14 28, 4150 Krefeld	●								
Plissee Johannes GmbH Siemensstr. 2a, 8012 Ottobrunn									
Kaeppel, Adam Postfach 10 19 27, 8900 Augsburg 1									
KBC Sport und Freizeit, Manufaktur Koechlin, Baumgartner & Cie. AG, Postfach 45, 7858 Weil am Rhein 5	●	●	●						
KBC-Manufaktur Koechlin, Baumgartner & Cie Postfach 17 20, 7850 Lörrach	●	●	●						
Kindermann GmbH An der Umfluth 31, 4530 Ibbenbüren									
Kleber Textil GmbH & Co. KG Postfach 31, 6842 Bürstadt									
Arnold Kock Textil Postfach 23 20, 4430 Steinfurt									
König, Gustav, GmbH & Co. Postfach 20 20 06, 5600 Wuppertal 2						●			
Königsberger, Jos., GmbH & Co. KG, Kalkbergstr. 49 – 53, 5100 Aachen		●							
Kollektion Feller Sport u. Loden 7907 Langenau-Garching									
Kollektion Team 2L 7907 Langenau-Lauingen									
Korb-Design GmbH Nagler Weg 9, 8591 Fichtelberg						●			
Korter & Co. KG Postfach 15 36, 6800 Mannheim 1									●
J. Krebs GmbH & Co. KG, Postfach 12 64, 4156 Willich-2 Anrath		●			●				
Kunert, Heinrich, Textilwerke GmbH & Co. Postfach 15 27, 8990 Lindau/Bodensee	●	●	●						
Lacoray GmbH, Marienstr. 20, 4000 Düsseldorf 1									
Spinnerei Lampertsmühle AG, Postfach 22 20, 6750 Kaiserslautern 26							●		

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجة	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Wilhelm Langendorf GmbH Postfach 62, 8641 Marktrodach									
Plissée-Lassner ach 210, 6430 Bad Hersfeld	●								
L. .enmühle GmbH Postfach, 7890 Waldshut-Tiengen 2									
Linne, L., KG, Postfach 20 07 27, 5600 Wuppertal 2						●			
Lorenit Stoffe GmbH, Holzhauser Str. 155, 1000 Berlin 27	●	●	●						
Malzahn, Eugen, KG Postfach 20 62, 5860 Iserlohn						●			
Emil Marggraff Tuchfabrik GmbH, Postfach 27, 7623 Schenkenzell	●	●	●		●				
Maschentex GmbH Postfach 19, 7905 Dietenheim	●								
Melchior GmbH, Postfach 11 55, 7317 Wendlingen	●	●	●		●				
Meyer, Doris 7452 Haigerloch-Karlstal									
Milo Vertriebsgesellschaft mbH Postfach 12 04 06, 5630 Remscheid 11									
Mode-Information Heinz Kramer GmbH Postfach 11 80, 5063 Overath								●	
Modital-Zubehör GmbH Landgrafenring 20 – 22, 6050 Offenbach									
Arthur Mönch GmbH & Co. KG Postfach 22 02 28, 5600 Wuppertal 22					●	●			
Moll, Fritz, GmbH & Co. KG, Postfach 11 53, 7963 Altshausen						●			
Mosters, Stockhorst & Co., Postfach 267, 4290 Bocholt									
MR création Maute & Renz Textil GmbH Primelweg 19, 7470 Albstadt 2									
[illegible] S Sportswear GmbH ch 220, 4290 Bocholt									
Mu[illegible]orter Zeugdruckerei u. Färberei, H. Bresges GmbH & Co. Duvenstr. 98 – 262, 4050 Mönchengladbach 2	●								
Müller & Co., Postfach 20, 8531 Diespeck/Aisch					●	●			
Müller, M., KG, AS-Automatenstickerei, Postfach 60, 8531 Diespeck/Aisch	●		●		●	●			
Müller Textil GmbH Postfach 31 40, 5276 Wiehl 3 Drabenderhöhe									
Nagler & Sohn, Textilwerke Augsburg Postfach 10 21 67, 8900 Augsburg									
NAK Stoffe AG, Postfach 10 21 69, 8900 Augsburg	●		●						
Neue Baumwoll-Spinnerei u. Weberei Hof AG, Textilgruppe Hof Postfach 15 29, 8670 Hof/Saale									
Neuenkirchner Textilwerke Hecking GmbH & Co. KG Postfach 100, 4445 Neuenkirchen									

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
NINO AG, Postfach 20 29, 4460 Nordhorn	●	●	●	●					
NINO AG, Sparte Garne, Postfach 20 29, 4460 Nordhorn							●		
Nobilis GmbH & Co. KG, Postfach 23, 2833 Harpstedt						●			
Nobilis-Textil-GmbH Postfach 13 61, 4424 Stadtlohn	●								
Nönning, Fritz, -N- Interlock Waldseiter Str. 17, 4444 Bad Bentheim									
Nordena-Jersey GmbH, Postfach 22 24, 2350 Neumünster	●								
Eugen Ott und Söhne GmbH & Co. Postfach 430, 7470 Albstadt 1	●								
K. Jos. Otten Postfach 230, 4050 Mönchengladbach 1	●	●							
Pauen, Franz Max, GmbH, Postfach 69, 4154 Tönisvorst 1	●								
Pegasus — Textildruck Produktionsges. mbH Derchinger Str. 98, 8900 Augsburg 41	●								
Pharetra Gesellschaft mbH & Co., Postfach 11 05, 8671 Selbitz/Bayern	●	●	●		●				
Piraiki Patraiki van Delden Textil AG Postfach 13 62, 4434 Ochtrup	●	●	●						
Pliester, Martin, GmbH & Co. Postfach 25 03 30, 5600 Wuppertal 2						●			
Plissee — Endrix Bergstr. 4 – 6, 5657 Haan 2					●				
Ploucquet, C. F., GmbH & Co., Postfach 17 40, 7920 Heidenheim a. d. Brenz	●	●	●	●	●				
Polaris Textilvertrieb GmbH Industriestr. 12, 6603 Sulzbach/Saar									
G. L. Pott + Hinrichs GmbH + Co. Postfach 10 08 68, 5600 Wuppertal 1									
William Prym-Werke GmbH & Co. KG Postfach 17 40, 5190 Stolberg						●			
Q + M — Team Au. Bünger, BOB-Textilwerk KG GmbH & Co. Wichlinghauser Str. 38 – 40, 5600 Wuppertal 2									
Quack, Gustav, GmbH + Co. KG Postfach 21 10 01, 4050 Mönchengladbach 2	●								
Ravensberger Spinnerei AG, Postfach 67 40, 4800 Bielefeld 1							●		
B. Rawe GmbH & Co. Postfach 22 49, 4460 Nordhorn									
Reichart, J. R., GmbH, Postfach 31 40, 8990 Lindau/Bodensee	●		●						
Reissmann, Walter, GmbH & Co., Postfach 540, 8660 Münchberg/Ofr.	●	●	●						
Rettig, Hermann, Textilges. mbH. & Co. KG, Benzstr. 1 – 3, 5090 Leverkusen 3	●					●			
Rhodia AG Postfach 13 20, 7800 Freiburg							●		
Riedel & Tietz GmbH Salzufer 14a, 1000 Berlin 10									

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجة	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Riedinger Textil GmbH, Riedingerstr. 24, 8900 Augsburg 1	●								
P ke Etiketten K. Rinke GmbH & Co. KG ach 13 40, 4322 Sprockhövel 1						●			
BUSO-Stahlwarenfabrik, Buntenbach & Sohn GmbH, Postfach 17 02 20, 5650 Solingen 17						●			
Roloff-Seidenherstellung Sperberhorst 9, 2000 Hamburg 61 (Niendorf)									
Rüth Textil GmbH Dammweg 2–6, 6110 Dieburg	●								
Rummeny, Josef GmbH + Co. KG, Postfach 14 47, 5100 Aachen	●								
Rump & Neumann GmbH & Co. KG, Oststraße 68, 4900 Herford						●			
Rump, Ernst, Westfälische Baumwollweberei Postfach 520, 4290 Bocholt									
Sager, C., Söhne & Co. GmbH., Postfach 24 40, 2350 Neumünster 1	●	●							
Schaeffer-Scovill Verbindungstechnik GmbH, Schützenstr. 23, 5600 Wuppertal 2						●			
Dr. Schedler, World Art Exclusiv Meierstr. 63, 4900 Herford						●			
Scheibler, Peltzer GmbH & Co., Postfach 26 20, 4150 Krefeld 1	●	●	●						
Hans Schmidl GmbH Postfach 209 u. 248, 7481 Bingen üb. Sigmaringen					●				
Scholl Bijouterien GmbH Stettiner Str. 17, 8950 Kaufbeuren						●			
H.A. Schmitz GmbH Postfach 20 14 07, 5600 Wuppertal 2									
Atelier Schroeder Windberger Allee 22, 4050 Mönchengladbach 1									●
Ernst Schröder oHG, Postfach 25 03 29, 5600 Wuppertal 2						●			
nder, J., Söhne GmbH & Co. KG tfach 13 40, 4443 Schüttorf	●	●	●	●	●		●		
G. Schümer GmbH & Co., Postfach 13 60, 4443 Schüttdorf	●	●							
Schulte, Reinhard, GmbH Postfach 10 01 89, 4100 Duisburg 1									
F. & H. Schumann GmbH & Co. KG Hinterer Flossanger 10, 8630 Coburg									
S.C.O.T. – DIC Pilgerstr. 20, 5063 Overath									
Seiba Säckingen Hackelsberger GmbH & Co. KG Postfach 11 47, 7880 Bad Säckingen 1	●								
Seidenweberei Reutlingen Gerstenberg oHG Postfach 25 61, 7410 Reutlingen 1	●								
Seyffert, C., GmbH Postfach 13 66, 8674 Naila/Bayern	●	●	●	●	●				
SMI-Textilgesellschaft mbH Otzbergstr. 14, 6074 Rödermark									

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Sola Gürtelfabrik Kurt Müller GmbH & Co. KG Postfach 845, 7290 Freudenstadt									
Stern Textil GmbH Lindigstr. 3, 8752 Kleinostheim									
Stickerei Karla GmbH & Co. KG Cranger Str. 184 – 186, 4650 Gelsenkirchen						●			
Stocko Metallwarenfabriken Henkels u. Sohn Postfach 13 01 53, 5600 Wuppertal 1					●	●			
Stoffel & Sohn GmbH Postfach 10 13, 7750 Konstanz								●	
Stragapede-Didra, Atelier für Textilgestaltung Rauhgasse 6, 7750 Konstanz									●
Surrogat Hofer Str. 26, 8660 Münchberg									
Texport GmbH Postfach 22 24, 2350 Neumünster	●	●							
Textilgesellschaft Gschwilm mbH Postfach 10 25 22, 8900 Augsburg	●	●							
Textilwerk Rhenania GmbH, Postfach 1120, 5144 Wegberg	●	●							
Thümmler & Bley, Waldstr. 3, 8678 Schwarzenbach/Wald	●		●						
Trans-Textil-GmbH Postfach 16 80, 8228 Freilassing	●								
Transfer Modedruck GmbH Ihringer Landstr. 16, 7814 Breisach									
Tuchmacher, Postfach 11 64, 7907 Langenau	●	●	●						
TVG GmbH Postfach 26 04, 4150 Krefeld 1									
ULMIA, Steiger & Deschler GmbH., Postfach 38 20, 7900 Ulm	●			●					
Union Gürtel GmbH Wernerusstr. 12, 3100 Celle									
Union Knopf GmbH, Postfach 11 02 80, 4800 Bielefeld 11					●	●			
Unique Mode-Textil GmbH Postfach 12 60, 7814 Breisach									
Verband Deutscher Designer Postfach 22 02 47, 8000 München 22									●
Verseidag-Futterstoffe GmbH Girmesgath 5, 4150 Krefeld 1				●	●				
Vossen, Frottierweberei, GmbH Neuenkirchener Str. 97, 4830 Gütersloh 1									
A. Wattendorff GmbH & Co. KG Postfach 25 40, 4430 Steinfurt									
Weber & Ott, Aktiengesellschaft, Postfach 7, 8550 Forchheim/Oberfr.	●	●	●						
Webstoffe Waiblingen GmbH, Postfach 17 66, 7050 Waiblingen	●	●	●	●					
Horst Weihrauch Uerdinger Str. 248, 4150 Krefeld									●
Weiss, C. F. GmbH & Co. KG, Postfach 12 40, 8662 Helmbrechts/Ofr.	●								

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Wenzelband A. Wenzel KG Bandweberei Postfach 14 67, 5550 Bernkastel-Kues						●			
Wi[illegible]he, Hans GmbH, [illegible]er 13, 1000 Berlin 10	●	●	●		●				
W[illegible]e + Wittauer GmbH & Co. Textil KG Postfach 13 01 41, 8500 Nürnberg 13									
Wisa-Stoffe W. Sax GmbH & Co., Postfach 20, 7200 Tuttlingen	●								
wolbo Wilh. Wolterink & Comp. KG Postfach 523, 4290 Bocholt									
Wolldeckenfabrik Weil der Stadt AG., Postfach 14 60, 7252 Weil der Stadt 1	●	●							
Spinnerei u. Webereien Zell-Schönau AG Postfach 11 20, 7863 Zell im Wiesental	●	●	●						
Zanner GmbH Königsberger Str. 2, 5600 Wuppertal 2									
Zuleeg, Wilhelm, GmbH, Postfach 11 80, 8662 Helmbrechts-Ort									

Finnland — Finland — Finlande Finlandia

フィンランド

فنلندا

Oy Finlayson AB P.O. Box 42, SF-28101 Pori									
E. Helenius OY, SF-36720 Aitoo									
Oy Terinit AB, SF-68700 Terjärv									
T[illegible] Oy, Box 28, SF-10301 Karis	●	●							

Frankreich — France — France Francia

フランス

فرنسا

Achille Bayart et Cie. Boite Postale 317, F-59056 Roubaix								●	
Alba la Source, Le Moulin Gaû S.A. B.P. 501, F-81201 Mazamet Cedex									
Ets. André Avio S.A., B.P. 3, F-59540 Caudry									

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製品区分 مجموعة الدول المنتجه	١	٢	٣	٤	٥	٦	٧	٨	٩
Aimé Baboin, Société Nouvelle 31 – 33, Rue Royale, F-69001 Lyon									
S. A. Francois Bacus 11, Rue des Bosquets, F-54302 Luneville	●								
Mathieu Balas, B.P. 2, F-42152 L'Horme									
Barda, Victor, 69, Rue d'Hauteville, F-75010 Paris	●								
Beaux Valette 9, Rue du Garet, F-69001 Lyon	●								
Bel Maille B.P. 6, F-42153 Riorges	●	●	●						
Berglas-Kiener, – Groupe Cernay S.A. – B.P. 49, F-68001 Colmar Cedex	●	●	●				●		
Ets. M. Berny 1, Place Louis Pradel, F-69001 Lyon	●								
Bianchini-Ferier SA, 4, Rue Vaucanson, F-69283 Lyon Cedex 1	●								
Billion & Cie., P. Box 4467, F-69241 Lyon Cedex 1							●		
Billon Frères, 40, Rue Descartes, F-69607 Villeurbanne	●				●				
Blanc, Marcel, S.A., Les Tissus, 21, Rue de Cléry, F-75002 Paris	●		●						
Pierre Blanc 75, Rue de Gerland, F-69001 Lyon									
Bloch et Cie B.P. 21, F-68160 Sainte Marie aux Mines									
Boisson Frères, 8, rue du Griffon, F-69001 Lyon									
C. J. Bonnet 1, Place du Griffon, F-69001 Lyon	●								
J. Bord, 21, Rue Ste-Geneviève, F-69006 Lyon	●								
Bournaud, François 35, rue des Pt. Champs, 75001 Paris									●
Tissus Boussac, Dept. CBSF 131, Rue du Bac, F-75340 Paris Cedex 07	●								
Bouton-Renaud S.A., 16, rue Crillon, F-69006 Lyon	●		●						
S.A. Bracq 45, Rue de St. Quentin, F-59540 Caudry									
Brochier, J., Soieries 51 – 53, Montée de la Grande Côte, F-69001 Lyon	●								
Bucol Buchet Colcombet, B.P. 6411, F-69413 Lyon Cedex 06	●				●	●			
Atelier Calasti 23, Quai Voltaire, F-75007 Paris									●
Sté. de Cathalo, S.A. B.P. 32, F-81104 Castres	●								
Le Centre Textile de Lyon 55, Montée de Choulans, F-69005 Lyon									
Cernay S.A., 1a, rue Sandoz, F-68700 Cernay	●	●	●				●		
Chastex Europe 11, Av. du Polygone, F-42300 Roanne									

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Soieries Henry Chavanis Rue de la Bourse No. 4 u. 6, F-69001 Lyon									
Cifran Sotta [illegible]2, F-95380 Louvres									
[illegible]arenson & ses Fils 34, Allée Corbière, F-81104 Castres									
Dessins Clay 7, rue Daunou, F-75002 Paris									●
Clement Frères, 77/79, rue de Seze, F-69006 Lyon									
Cortex SA B.P. 48, F-69752 Charbonnieres Cedex									
Cosserat, Man. de Velours et Cotons B.P. 0910, F-80009 Amiens Cedex									
Dalle S.A. Boite Postale 9, F-59117 Wervicq-Sud									
Dentelles Darquer 56, rue des Quatre Coins, F-62100 Calais	●								
Decouvelaere Lepanges sur Vologne, F-88600 Bruyeres									
Dechelette Frères, F-42840 Montagny	●								
Groupe Delcher S.T.A. Numas Par Ardoix, F-07290 Satillieu									
Le Textile Delcer 33, Rue Richard Lenoir, F-02101 St. Quentin									
Depeche Mode 20—22, Rue de Clichy, F-75009 Paris									
D'Este France 9, rue Lincoln, F-75008 Paris									
Devaux S.A. Saint Vincent de Reins, F-69240 Thizy									
Diagonale S.A. Rue du 11 Nov 1918, F-09600 Laroque d'Olmes									
Diochon, Soieries 1[illegible] Place Tolozan, F-69001 Lyon									
[illegible] — Service Expositions 86, rue de Rivoli, F-75180 Paris Cedex 4									
A. Facques & Fils 27, rue du Fort, F-59055 Roubaix Cedex 1									
Faure, Julien, Ets. & Cie., 22, Rue Thimonnier, F-42100 St. Etienne	●					●			
Fédération Française du Tissage de Laine 12, Rue d'Anjou, F-75008 Paris									
Foglierini, Claude Sarl., Latinages & Jersey 39, Bld. Albert 1er, F-81204 Mazamet Cedex									
FORESTYLE, 3, Quai Jean Moulin, F-69001 Lyon	●								
France Elde 136, Fbg. St. Honoré, F-75008 Paris									●
Tissus Gailliard Dept. de Cie Boussac S.N.C. 201, Av. Andre Maurois, F-76360 Barentin									
Gap Group Covergence 14, Rue Chaptal, F-92300 Levallois									

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Ets. Gerson 107, Blvd de Sebastopol, F-75002 Paris					●				
Gewe S.A., 104, Rte. de Hausbergen F-67088 Strasbourg Cedex									
Gillier Freres, 20, Rue Joseph Serlin, F-69001 Lyon									
Girgis Fontvieille S.A., 47, Av. Gabriel Peri, F-69960 Corbas	●	●	●						
Girodet S.A 50, Avenue de la Résistance, F-4220 Bourg Argenta									
Soieries Gotheil 25, Rue de la Viabert, F-69006 Lyon									
Ets. A. Goutarel SA Verlieu-Chavanay, F-42410 Pelussin	●								
Griffine-Marechal 35/41, Rue du Capt. Guynemer, F-92090 Paris la Def.									
Groupe Creations Sarl. 40, rue de Chabrol, F-75010 Paris									
GUIGOU S.A., 89, Rue Jacquard, F-69004 Lyon	●	●			●				
Guyon, Charles 13, rue Royale, F-69001 Lyon									
Haumesser, Dominique 35, rue des Petits Champs, F-75001 Paris									
Hinsinger, Henri, Fabr. de Soieries 1, Place du Griffon, F-69202 Lyon Cedex 1									
JENAST S.A., Rue de Cléry 21, F-75002 Paris	●								
Edouard Jouret 13, Rue de l'Hospice, F-59054 Roubaix Cedex 1									
Journal du Textile, 61, Rue de Malte, F-75541 Paris Cedex 11								●	
Maison Kandelaft (Fabricants de Soierie) 77/79 Rue de Seze, F-69006 Lyon									
Komar & Cie. S.A., 16/18, Façade de l'Esplanade, F-59800 Lille	●	●	●						
Kvanevski and Co. 40, rue St. Anne, F-75002 Paris									●
Lang, Emanuel, Quai de Rotterdam, F-68110 Illzach	●	●	●						
André Laude, Dentelles 18, Rue J.J. Rousseau, F-59540 Caudry	●								
Albert Lecomte et Fils B.P. 144, F-59333 Tourcoing Cedex									
Lenoy B.P. 3, F-42210 Montrond les Bains									
Lepoutre S.A. 156, Chauss. P. Curie, F-59202 Tourcoing Cedex									
Societé Macknit 2, rue Louis Leloir, F-59200 Tourcoing									
Ets. A. Masurel B.P. 2001, F-76380 Canteleu									
S.A. Mati B.P. 38, F-68800 Vieux-Thann									

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجة	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Ets. Roger Manoha S.A. Felines, F-07340 Serrieres									
Manufacture Textile Moulines 8, F-9300 Lavelanet									
L alles Mery S.A.R.L. B.P. 45, F-59540 Caudry						●			
Modes & Techniques de Paris 21, Rue de Faubourg, F-75009 Paris									
Gilbert Molinier B.P. 172, F-81101 Castres Cedex									
Nesme, Michele et Antoine 11, Quai Andre-Lassagne, F-69001 Lyon									●
PICHAT CHALEARD, Rue d'Alsace-Lorraine 21, F-69001 Lyon	●	●			●				
Promostyl 1, rue François 1er, F-75008 Paris									●
Prudhomme Frères 69, Rue de Richelieu, F-75002 Paris									
Rhône-Poulenc-Fibres Exp. 25, Quai Paul-Doumer, F-92408 Courbevoie									
RIECHERS, S.A., Route de Calais 1728, F-62730 Marck	●				●				
Risler Tissu, Saint Germain, F-70200 Lure									
Ets. A. Roudiere & Cie. 6, Rue Mirabeau, F-09300 Lavelanet									
Saic Velcorex, B.P. 189, F-68314 Illzach Cedex									
Saint – YS 3, rue Roger Salengro, F-69009 Lyon									
S.A.R.L. Tissavel 2 A 8, Rue de Linselles, F-59250 Halluin									
Scheurer, Lauth S.A., B.P. 37, F-68800 Thann	●		●						
Sebel S.A. 75, Rue de Gerland, F-69007 Lyon									
A.N., Usine de l'Esperance 2, F-Floing 08200 Sedan									
Soieries Sfate & Combier, B.P. 6642, F-69413 Lyon Cedex 06	●								
Sitel, S.A. Oyeu, F-38690 Le Grand-Lemps				●	●				
Société des Textiles en Biais 45a, Aven. du General de Gaulle, F-68302 Saint-Louis						●			
Société d'Impressions & Nouveautés, S.I.N. 8 et 10, rue St-Polycarpe, F-69203 Lyon	●		●						
Société Industrielle Altkirchoise de Textiles S.I.A.T. B.P. 4, F-68130 Altkirch									
Société Nouvelle Peltex B.P. 56, F-88102 Saint-Die Cedex									
Soierie Chambutaire 44, rue Claude Protière, F-42140 Chazelles sur Lyon									
Soieries Roger Cheval 16, Quai André Lassagne, F-69001 Lyon									

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Solstiss S.A.R.L. 61, Rue du Marechal Leclerc, F-59540 Caudry	●					●			
Création Soma 7, rue du Bray, F-78400 Chatou									
Ets. Steinheil-Dieterlen, G. Marchal Fils S.A., 3, Grand Rue, F-67570 Rothau	●			●					
Stylist's Information Services 16 Bd. Montmartre, F-75009 Paris									
Sublistatic International 1535 Blvd. f. Darchicourt, F-62110 Henin-Beaumont								●	
Emile Tardy S.A. 11 – 13, rue de Meons, F-42005 Saint-Etienne Cedex 1							●		
Soieries T.B.M. B.P.2 Fourneaux, F-42470 St. Symphorien-de-Lay									
Syndicat Général de l'Industrie cotonnière Française 3, Avenue Ruysdael, F-75008 Paris									
Teintureries de la Turdine B.P. 32, F-Tarare 69170									
Tersac 183, Avenue de l'Industrie, F-69140 Rillieux la Pape									
Michel Thierry S.A. F-09600 Laroque d'Olmes									
Paul & Jean Tiberghien S.A. 105, Rue de Lille, F-59203 Tourcoing									
T.I.M., Chemin des Joncs, F-69570 Dardilly									
Tissafil SA 13 Ave. Bat. Carm. Liberté, F-69120 Vaulxen-V.									
Tissage des Chaumes Edler et Lepavec S.A. B.P. 51, F-68160 St. Marie-aux-Mines									
Tissages des Alpes 19, Place Tolozan, F-69281 Lyon Cedex 1									
Tissages du Royans Saint Laurent en Royans, F-26190 St. Jean en Royans									
Tissus Togonal 69, rue de Chabrol, F-75010 Paris									
Tissus T.S.R. La Bergère F-07290 Satillieu									
Tournier & Fils, S.A. des Filiatures et Tissages B.P. 23, F-81201 Mazamet Cedex									
T.S.N.I. SA 11, Av. Bataillon Carmagn. Liberté, F-69009 Lyon									
Valenson Sarl 10 bis, Rue du Mal Leclerc, F-59540 Caudry									
Jean Valette S.A. Les Salvages, F-81100 Castres									
Velours de France 55, Rue de Turbigo, F-75003 Paris				●					
Voiron-Chartreuse, Tissages, 14-16, Rue Louis Guerin, F-69100 Villeurbanne	●								
Warnier-David Diffusion 2, rue Clovies Chezel, F-51051 Reims Cedex									
Wurmser, P. & C., B.P. 272-02, F-75063 Paris Cedex 02	●	●							

Produktgruppen/Product Groups/Groupes de Merchandises	1	2	3	4	5	6	7	8	9
製品区分 مجموعة الدول المنتجه	١	٢	٣	٤	٥	٦	٧	٨	٩
Griechenland – Greece – Grèce – Grecia シア اليونان									
Aegean Mills S.A., 28, Mikras Assias Str., GR-18547 Piraeus	●	●	●						
Piraiki – Patraiki Cotton Manufacturing Co. Inc. 2, Kalamiotou Street, GR-10563 Athen	●	●	●						
Vomvix S.A., 136 Avenue Kifissos, GR-12131 Peristeri/Athens	●								
Großbritannien – United Kingdom of Great Britain and Northern Ireland – Grande-Bretagne – Gran Bretagna イギリス انجلترا									
David + John Anderson Primet Mills, GB-Iolne Lancs. BB8 8DP									
Ashton Shirtings Primet Mills, GB-Iolne Lancs. BB8 8DP									
Belmont Weaving P.O. Box, Moss Lane Walkden, Worsley, Manchester									
ords PLC. P.O. Box 2, GB-Congleton, Cheshire CW12 1EF/GB.									
Brit. Mohair Spinners Ltd. P.O. Box 58, Midl. Mills, GB-Bradford BD1 4 RL				●					
Broadhead & Graves Kirkheaton Mills, Huddersf., GB-West Yorksh. HD5 0NS					●				
M. Brody Ltd. Strype St., GB-London G1 7LQ			●						
Burlington/Klopman 19 – 25 Argyll Street, London W1V 1AA					●				
Burlington Sportswear Fabrics 19 – 25 Argyll Street, London W1V 1AA									
Calvacade fabrics 13 – 14 Margaret St., GB-London W1A 3DA									
Clan Woollens (Export) Ltd. Woodside Walk, Hamilton, Scotland ML3 7HZ									
Courtauld Prints 13 – 14 Margaret St., GB-London W1A 3DA									

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Samuel Courtauld Leonard Str., GB-Nottingham NG8 8RS									
Courtaulds Acetate 13–14 Margaret St., GB-London W1A 3DA									
Courtaulds Courtelle 13–14 Margaret St., GB-London W1A 3DA									
Courtaulds Fabric Group 13/14 Margaret St., GB-London W1A 3DA									
Courtaulds Fibres 13–14 Margaret Street, London W1A 3DA									
Courtaulds Viscose Europe 13–14 Margaret St., GB-London W1A 3DA									
Glen Cree Ltd. Newton Stewart, Wigtownshire GD8 6DH Scotland									
Crombie Aberdeen, GB-Scotland AB1 2SA									
Denholme Velvets Ltd. Halitex Rd., GB-Bradford BD13 4EZ West Yorksh.									
Benjamin Dent & Co. Ltd. 33 Bredford Place, GB-London WC18 5JX									
Derby Nyla Acton Rd., GB-Nottingham NG10 1FX									
Everlasting Pleating Co. Ltd. Brody Hs., Strype St. GB-London E1 7LQ									
First Eleen 51 Lyndhurst Way, London SE15 5AG									●
Furphy Simpson 234 Rye Lane, Peckham									●
Garigue 31/35, Beak Str., GB-London W1R 4EL									
Greenwood Mills International Ltd. 1 Dorset Street, London W1H 3FB/G.B.									
Guilford Kapwood Ltd. Birchwood Way, Somercotes, GB-Derbysh. DE55 4NJ			●						
ICI Fibres Hookstone Road, Harrogate/Yorksh. HG2 8QN/G.B.				●					
Illingworth Morris Group Kirkheaton Mills, GB-Huddersf., West Yorksh. HD5 ONS									
International Design Exchange dl Metropolitan Wharf, Wapping Wall, London E1 9SS									●
S. Jacoby Ltd. Brody Hs., Strype St., GB-London E1 7LQ									
Josiah France Kirkheaton Mills, Huddersf., GB-West Yorksh. HD5 0NS									
Liberty of London Prints Ltd. 313 Merton Road, Wandsworth SW18 5JS									
Laeroyd Brothers & Co. Kirkheaton Mills, Huddersf., GB-West Yorksh. HD5 0NS									
Jill Lawrence Desgin One Wild Hatch, Meadway Gate, London NW11 7LD									●

Produktgruppen/Product Groups/Groupes de Merchandises	1	2	3	4	5	6	7	8	9
製品区分 مجموعة الدول المنتجه	١	٢	٣	٤	٥	٦	٧	٨	٩
Lewis Stone Design Group 15 Lindhurst Way, London SE15 5AG									●
n Litmen Ltd. Radford Rd., Basf., GB-Nottingham									
muel Lumb & Son Ltd. Elland, GB-West Yorkshire HX5 9AX				●					
Peter Macathur & Co. Ltd. Woodside Walk, Hamilton, Scotland ML3 7HZ									
Martin Sons & Co. Kirkheaton Mills, Huddersf., GB-West Yorksh. HD5 0NS									
Thomas Mason Ltd. Primet Mills, Colne, GB-Lancs BB8 8DP									
Moygashel Ltd. 17 Bedford Row, GB-London WC1									
RG Neill & Son/Reid & Welsh Glenesk Mills, GB-Scotland DG13 0LA									
N.W.T.E.C. 43 Hustler Gate, GB-Bradford BD1 1PE									
C M Offray & Son Ltd. Fir Tree Place, Church Road, Ashford, Middlx. TW15 2PH/GB.									
OMC Group Ltd. Oakes Mills, Huddersf., GB-West Yorksh. HD3 4BY									
Arthur Phelps & Co. Ltd. 490 Radford Rd., Basf., GB-Nottingham									
Reid + Welsh Glensk Mills, GB-Langholm DG13 OLA									
Robertson Winfield Prior Studio One 71 Waldbeck Road, London N15									●
Schwerzschild Ochs Ltd. 4 Berners St., GB-London W1P 4BS									
Sperrin Textiles Ltd., Mortimer House 46 Sheen Lane, London SW14 8LP/G.B.									
Suncourt fabrics P.O. Box 3, Walkeden Worsley, Manch. M28 5WB									
abrics 13/14 Hanover St., GB-London W1R 9HG									
Taylor & Lodge Albert Str. Huddersf., GB-West Yorksh.									
Jonathan Thorp Back Church Lane, GB-London G1 1LS									
Toray Europe Ltd. 35–38 Portman Square, London W1H 0BS/G.B.									
Transprints Division Southgate, Morecambe LA3 3DA, Lancs.									
West Point Pepperell Inc. 1 Dorset Street, London W1H 3FB									
W. E. Yates Grandholm Works, GB-Abderdeen AB1 2SA									
The Yorkshire Woollen/Jonathan & Thorp Back Church Lane, GB-London E1 1LS									

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Hongkong — Hong Kong — Hong Kong — Hongkong 香港 هونج كونج									
Toray Industries (HK) Ltd., 3rd Floor TAL Building, 49 Austin Road, Kowloon/Hong Kong									
Indien — India — Indes — India インド الهند									
Annapoornesh Exports 21 Haddows Rd., IND-Madras 600 006	●								
Bharat Silks Jumma Masjid Road., Bangalore 560002	●								
Banaras House Ltd. 27 Barakhamba Rd., IND-Neu Delhi 110 001	●								
Century Spinning Mfg. Co. Ltd. Dr. A. Besant Rd., IND-Bombay 400 025	●								
Co-Optex Int. 350, Pantheon Rd., IND-Madras 600 008	●								
The Cotton Textiles Export Promotion Council 9 Mathew Rd., IND-Bombay 400 004	●								
Eastern Sick Ind. Ltd. 19 R. N. Mukherjee Rd., IND-Calcutta 700 001	●								
J. J. Exporters Ltd. 4 Government Pl. Nth., IND-Calcutta 700 001	●								
The Handloom Export Promotion Council 622 Anna Salai, IND-Madras 600 006	●								
Hanuman Weaving Factory P.O. Box 7949, IND-Bangalore 560 053	●								
Indian Textiles Co. Private Ltd. 103 Embassy Centre, Nariman Point, Bombay-400021/Indien	●	●							
Kejriwal Enterprises Bentinde Street, IND-Calcutta 700 001	●								
Mafatlal Ind. Ltd. Nariman Point, IND-Bombay 400 021	●								
A. D. Jeaverpandic Nadar IND-Madrasi	●								
Siltex International 18/1 Andree Road, Bangalore — 560 027	●								

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
M. D. Supfa Exports Ltd. IND-Bombay	●								
Swan Silk Fabrik Box 7776, Bangalore-560053	●								
de Fair Authority of India, Pragati Maidan New Delhi — 110 001	●								
Zenith Export Ltd. 19 R. N. Mukherjee Rd., IND-Calcutta 700 001									
Irland — Ireland — Irlande — Irlanda アイルランド ايرلاندا									
Coras Trachtala Irish Export Board Merrion Hall, Strand Rd., IRL-Sandymount Dublin 4									
Emblem Weavers Ltd. Whitemill Ind. Est., IRL-Wexford									
McNutt Weaving Co, Ltd. Downings Donegal									
Italien — Italy — Italie — Italia イタリア ايطاليا									
L'Agenzia Italiana SAS Import Export Via Cilea, 33, I-50047 Prato									
Agnona S.p.A., Lanerie C.P. 76, I-13011 Borgosesia/Vercelli									
Albatex Srl. Via Borgovico 177, I-22100 Como	●								
Alberto & Roy Via Pietro Micca 8, I-13051 Biella									
Alcantara S.P.A. Via Mecenate 89, I-20138 Milano									
R. Allegri & F.lli Sas Via Montefortini, I-50040 Comeana FI	●								
Almar s.a.s., Via Forcella 3, I-20144 Milano	●								
Ambrosiana, Industria Tessile, Marra & C. S.p.A., Viale Zara 28, I-20124 Milano	●		●	●					
American Import-Export Srl. Via Nazionale, 39, I-50123 Firenze									

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Antilotex S.p.A., Cottonclub Viale Marconi 38, I-50047 Prato	●	●	●	●	●	●			
Aquerama Tesallidea srl. Via Mazzani 35, I-20053 Muggio MI									
Aquarius International Srl. Via Mazzini 35, I-20053 Muggio MI									
Aquilini Seterie S.R.L. P.O. Box 474, I-22100 Como 4	●								
L'Araldo G.I.A.C. S.R.L. Via Ciceri, 23, I-22100 Como									
Argenti S.P.A., Seterie, Via Risorgimento 23, I-22038 Tavernerio	●								
Federico Aspesi S.P.A. Via Maino 4, I-21013 Gallarte (VA7									
Man. Baggini S.P.A. Via L. Cicognara 2, I-20129 Milano									
Bari Disegni Via Borgo Vico, 126, I-22100 Como									●
Giordano Basso Srl. Via Roma 84, I-36042 Breganze/Vicenza	●	●							
Batex S.p.A. Via Provinciale 18, I-22038 Tavernerio	●								
Fratelli Becagli S.A.S., Viale Marconi 38, I-50047 Prato	●		●	●					
Bellieni S.P.A. Via Petrarca, 17, I-22100 Como	●								
Bettazzi, Lanificio F.lli S.N.C. P.O. Box 281, I-50047 Prato									
Binicocchi S.p.A. P.O. Box 424, I-50047 Parto S. Giusto									
Binimode Srl., Industria Tessile Via Pompei 5/7, I-50045 Montemurlo FI									
Bocci Fasoli Disegni L. Lario Trieste, I-22100 Como									●
Bomisa Bottoni Minuterie S.p.A. Via Idiomi 13, I-20090 Assago									
M. Bordogna S.P.A. Via Livescia 1, I-22073 Fino Mornasco Como	●								
Manifattura Borgomaneri S.p.A. Via G. Tenconi 1/a, I-21013 Gallarate	●								
Borromeo Manolo S.P.A. Via Masia 91, I-22100 Como	●								
E. Boselli & C. S.P.A. Via Carducci 11, I-22077 Olgiate Comasco									
BOSSI S.p.A., Via Galileo Galilei 5, I-28062 Cameri Novara	●	●	●	●					
Braghenti + C. S.p.A., Castellini Linea Casa. A. Via dei tre Corsi 21, I-21046 Malnate	●								
Luigi Bulgheroni, Seterie, S.P.A. Via Acquanegra 2, I-22100 Albate-Como	●								
CA. MA. Srl. Via Cantoniga, 11, I-22100 Como/Albate									
Lanificio Cangioli S.A.S. di C. Cangioli & Cie., Via del Bisenzio a. S. Martino, I-50047 Prato									

Produktgruppen/Product Groups/Groupes de Merchandises	1	2	3	4	5	6	7	8	9
製品区分 مجموعة الدول المنتجه	١	٢	٣	٤	٥	٦	٧	٨	٩
Cantoni Setilei S.p.A. Via Don Marzorati 24, I-21047 Saronno (VA)									●
Men. Ercole Cappio Srl. er Busto Arsizio 96/98, I-21054 Fragnano Olona									
Valli Cario S.p.A. Via Oltrecolli 60, I-22100 Lorai/Como									
Carvico S.p.A., Via Don A. Pedrinelli 52, I-24030 Carvico/Bergamo	●	●	●	●	●				
Castellanza & Borri S.p.A., Via d'Azeglio 14, I-21052 Busto Arsizio	●	●	●						
Lan. Fratelli Cecchi Via dello Sprone 5, I-50047 Prato	●								
Lan. Cecchi Lido & Figli S.p.A., Via Roma 308, I-50047 Prato	●	●	●						
Lan. Cecchi Paolo S.p.A. Via di Pratignone, 34, I-50041 Calenzano (FI)									
Ciemme Srl. Via J. Rezia, 15, I-22100 Como									
Sanzio Cipriani Via XXV Aprile N.2, I-50046 Poggio a Caiano (FI)									
Clerici Tessuto & C. S.p.A., Via E. Pessina 15, I-22100 Como	●								
Colombo S.P.A., Tessitura Serica Via Ferloni 1, I-22070 Bulgarograsso	●								
Comoexport Via Alessandro Volta 81, I-22100 Como	●								
Comojersey S.p.A. Via per Guanzate, I-22073 Fino Mornasco	●								
Comoquattro Snc. Disegni Tessili Via Rovelli 43, I-22100 Como									●
Corisia S.P.A. Via Sirtori 7 – 9, I-20129 Mailand	●								
I Cotoni di Sondrio Via Tonale 4, I-23100 Sondrio									
Cotorossi Commerciale SpA. Borgo Berga 3, I-36100 Vicenza									
n's Time S.p.A. Colombo, 90, I-21054 Fagmano Olona VA									
Tess. Crespi S.p.A., Industria Filiati Via C.B. Crespi 10, I-28074 Ghemme									
Tessitura di Crevacuore S.P.A. Corso Vercelli, 141, I-13011 Borgosesia									
Cuccirelli & C., Tessuti Fantasia S.P.A. Via Ercole Ferrario, 24, I-21013 Gallarate									
Cuomo S.R.L. Viale Cirene, 9, I-20135 Milano									
Edimoda S.P.A. Via Stromboli 1, I-20144 Milano									
Eliolola S.p.A. (Abt. Texmantovo) V.le Forlanini 39, I-20024 Garbagnate Milanese									
Emmeci di Michela Calcinai Via Grotto Vrago 25, I-22030 Montorfano Como									●
Enichem Fibre S.p.A. C.P. 3587, I-20097 San Donato Milanese									

Produktgruppen/Product Groups/Groupes de Merchandises	1	2	3	4	5	6	7	8	9
製品区分 مجموعة الدول المنتجه	١	٢	٣	٤	٥	٦	٧	٨	٩
Erica Ind. Tessile S.p.A. V.le Sabotino 253, I-20025 Legano (MI)	●		●						
Erretex S.R.L. P.O. Box 751, I-50047 Prato	●								
Lanificio Esse-Elle di Signorina Luciano S.A.S. Via delle Querce, 49, I-50010 Capalle									
Etro S.p.A., Via Spartaco 3, I-20135 Milano	●	●							
Eurojersey Tessuti Speciali SpA, Via S. Giovanni Bosco 260, I-21042 Caronno Pertusella	●								
Europ srl. Via S. Garovaglio 28, I-22100 Como									
Lan. Europa s.n.c., Via Montalese 176/C, I-50047 Prato	●	●	●						
Fasac S.p.A., Via Manzoni 6, I-22070 Cassina Rizzardi	●								
Fashion Trends Srl. Via Amalfi 20, I-50045 Montemurlo-Fi	●								
La Fenice Styling Pza. Volta 25, I-22100 Como									●
Lanificio A. Ferrarin S.p.A. Cas Postale 169, I-36016 Thiene	●								
Ferrario, Angelo, Tessile S.p.A. C.P. 29, I-21013 Gallarate	●		●						
Lan. Fratelli Fila S.p.A. Via Umberto 96, I-13013 Coggiola									
Tessile Fiorentina S.R.L. Via Fonda di Mezzana, 35a, I-50047 Prato									
F.I.S.A.C., S.p.A. Via P. Paoli 6, I-22100 Camerlata	●	●	●						
Fiser Srl. Via A. de Gasperi, I-25030 Zocco D'Erbusco									
Flem S.p.A. Via Bovio 23, I-21052 Busto Arsizio (VA)									
Lan. Florentia Srl Postfach 2097, I-50047 Prato									
Fornaciari S.P.A., Man. Tessile Via della Querce 23, I-50010 Capalle – FI –									
Ugo Foschi & C. s.a.s., Via Marcona 12, I-20129 Milano	●								
Fossati Lamperti S.P.A. Via Gaetano Casati 19, I-20052 Monza	●								
Fraccaroli Srl. Via Urago 13, I-22038 Tavernerio (CO)									
Franceschini S.p.A., P.O. Box 645, I-50047 Mentemurlo (FI)	●	●	●	●	●				
Francital S.R.L. Via Repubblica 56, I-13051 Biella – VC –									
L'Agenzia Italiana sas Via Cilea 33, I-50047 Prato	●								
Gartex, S.p.A. Via del Roccolo 18, I-21052 Busto Arsizio	●	●							
Manifattura di Gello S.P.A. Via di Gello 17/4, I-50047 Prato – FI –		●	●						

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Germania-Export, Consorzio Via Valentini, 14, I-50047 Prato (FI)									
L Aguzzi Giacobbe Srl. onizetti 33/35, I-50047 Prato									
getti Industria S.p.A. Via delle Querce, I-21013 Gallarate-Arnate/VA	●	●	●						
Guarisco S.P.A., F. Saldarini Catelli 7, I-22070 Grandate/Como	●	●	●			●			
Guglielmo Giani SPA. Via Castelmorrone 1, I-21052 Busto Arsizio			●						
Helitex S.p.A. Via Montecassino, 7, I-20025 Legnano									
Edizioni Hennessen Italia S.R.L. – Fashion Via Baracchini, 2, I-20123 Milano									
Hertess s.r.l. Via Benzi 3, I-22100 Como									
Incontro Moda S.R.L., Tessuti Alta Moda Via T. Gallio, 10, I-22100 Como						●			
Induno Industrie Tessile S.p.A. Via Jamoretti 21, I-21056 Induno Olona	●	●	●						
Intertex S.A.S., Tessuti di Alta Moda Viale Fasano 4, I-10023 Chieri (TO)									
I.R. Tessitura Pontelambro S.p.A. Via Carlo Cattaneo 18, I-22036 Erba									
Irsa S.P.A. P.O. Box 791, I-50047 Prato									
Italiana Pellicce V. le Spartaco Lavagnini 99, I-51031 Agliana PE									
Italtex Via Trossi 11, I-13051 Biella									
Tess. Italiane Riunite Srl. Via A. Grandi, 10, I-22100 Como									
Italvogue S.A.S. Via Gradisca, 15, I-21100 Varese	●								
I.T.M. di Ernesto Rota & C. S.a.S., le Gerbetto 2, I-22100 Como	●								
tea S.p.A., Corso Sempione 78, I-20015 San Lorenzo di Parabiago	●								
JERMI, S.P.A., Via del Dosso 15, I-22100 Como	●								
Kicomo Div. of Dante Prini Spa. Via Manzoni 10, I-22070 Lucino B. Como									
Kuhn, Benedikt, s.r.l., Via Galcianese, 107 M, I-50047 Prato	●	●	●		●				
Lanerossi S.p.A., Via del' Industria, 126, I-36015 Schio	●	●					●		
LANGAL S.P.A. Via Caravaggio 21, I-20052 Monza 1	●	●	●						
Lanificio Lamberto S.p.A., Via Strozzi 45, I-50045 Montemurlo									
Larusmiani Via Manzoni, 43, I-20121 Mailand									
Legler, Industria Tessile S.p.A., P.O. Box 66, I-24036 Ponte San Pietro/Bergamo									

Produktgruppen/Product Groups/Groupes de Merchandises	1	2	3	4	5	6	7	8	9
製品区分 مجموعة الدول المنتجه	١	٢	٣	٤	٥	٦	٧	٨	٩
Limonta S.p.A., Via C. Battisti 15, I-22041 Costamasnaga-Como-	●	●	●						
Linea Lady Via Fratelli Buricchi 68, I-50049 Vaiano									
Lanificio Linear S.p.A. Via Panzeria 32, I-50047 Prato									
Jersey Lomellina S.p.A. Via Don Angelo Pedrinelli No. 50, I-24030 Carvico-Bergamo									
Lan. Lorentex S.P.A. Via Viaccia 49, I-50045 Mazzone-Montemurlo	●	●							
Luciantex S.p.A., Via Privata Burgo 45, I-22026 Maslianico-Como-									
Lyontess srl. Via Fabio Filzi 27, I-20124 Milano									
Mabu Jersey S.p.A. Via Colombera 27, I-21048 Solbiate Arno									
Mafis, Via Manzoni 14, I-22070 Montano Lucino									
Manifattura Lane G. Marzotto & Figli S.p.A. Largo S. Magherita 1, I-36078 Valdagno									
Manifattura Tessile Pratese SPA C.P. 243, I-50047 Prato	●								
Manifattura Tobruc S.R.L. Via Pistoiese 138, I-50047 Prato	●								
Manteco S.p.A. P.O. Box 734, I-50047 Prato									
Lan. Franco Mantellassi S.A.S. P.O. Box 795, I-50047 Prato									
Riccardo Mantero Spa, Fabbrica Seterie Via A. Volta, 74, I-22100 Como									
Marioboselli Jersey Spa. V. alle Fonti, 57, I-24030 Mazzoleni di Omobono									
Marlane S.p.A., Via della Repubblica 65, I-87028 Praia a Mare									
Lan. di Mazzone S.A.S. Via di Viaccia-Mazzone 24/26 I-50045 Monte Murlo/Florenz									
Mectex S.p.A. C. Postale 78, I-22036 Erba -Como-	●								
Manifattura di Merate SPA. Via Cerri 51, I-22055 Merate (Como)	●								
Milior S.p.A. Via XXV Aprile 22, I-50040 Montemurlo	●	●	●						
Miroglio, Tessile, S.P.A. Strada Tagliata 18, I-12051 Alba	●		●						
Mizar S.p.A., C.so Sempione 194, I-21052 Busto Arsizio									
Moda Como S.R.L. Jacopo Rezia 15, I-22100 Como	●								
Modatex S.p.A., V. Magenta 16, I-20020 Robecchetto con Induno	●								
Montebello S.P.A. Via Fracanzana 16, I-36054 Montebello Vicentino									
Montefibre S.p.A. Via Pola 14, I-20124 Milano									

Produktgruppen/Product Groups/Groupes de Merchandises	1	2	3	4	5	6	7	8	9
製品区分 مجموعة الدول المنتجة	١	٢	٣	٤	٥	٦	٧	٨	٩
Monteolivetо Via Bizzarone 27, I-22077 Oglate Comasco									
M[illegible]ti, Tessitura S.p.A., [illegible]ltore, I-31052 Maserada S.P. –TV–	●	●	●						
M[illegible]ni Tessile SAS Via Bonicoli, 6, I-50047 Prato									
Motta Alfredo SPA Via Manara 3, I-20092 Cinisello Balsamo/MI									
Nanni-Costa, Francesco Via Ballarini 5, I-22100 Como									●
Nephila Srl., Tess. Alta Moda Via Vetreria, 1, I-22070 Grandate-Como 90									
Man. New-Jersey S.p.A. Via dei Confini 155, I-50010 Capalle									
Newdress di Tempesti Gimmi & C. Snc. Via G. Rossa 45 p, I-51037 Montale/Pt.									
Lan. Nova Fides S.p.A. P.O. Box 40, I-50045 Montemurlo									
Olmetex S.p.A. Via Canturina 10, I-22070 Olmeda di Capiago									
Marino Olmi, S.P.A., Lanificio P.O. Box 408, I-50047 Prato									
Giovanni Ones S.p.A., Via Vittorio Veneto 47, I-22079 Villaguardia/Como	●	●	●						
Tess. Orsenigo S.p.A. Via de Gasperi 10, I-22060 Figino Serenza	●								
Orsucci S.p.A. Via Ferrari 14, I-22100 Como									
Pandosia Spa P.O. Box 25, I-87012 Castrovillari									
Pentatex/Antess Via Vetreria 1, I-22070 Grandate CO									
Lan. F.lli Piacenza S.p.A. Casella Postale 381, I-13051 Bielle (VC)									
Picchi S.P.A., Lanificio V[illegible] Tempesti, 13, I-50047 Prato									
A[illegible] Pinto S.p.A., Via Roma 9, I-22070 Casnate	●								
Lan. Poker S.R.L. Via Marco Roncioni, 63, I-50047 Prato -FI-	●								
Tessitura Ponte Arno SPA Via C. Noe 33, I-21013 Gallarate	●								
Pontetorto S.p.A. P.O. Box 184, I-50045 Montemurlo (FI)									
Printed S.P.A., Via A. Magni 7, I-22100 Rebbio/Como	●								
Profilo srl., Man. Tessile C.P. 80, I-50045 Montemurlo									
Provex Via Milano 16, I-21100 Varese									
Punto Grigio Disegni Via Lonzillazione 74, I-22100 Como									●
Radici Man. Automatica S.p.A. Via Ca'Antonelli 55, I-24024 Gandino (BE)									

Produktgruppen/Product Groups/Groupes de Merchandises	1	2	3	4	5	6	7	8	9
製品区分 مجموعة الدول المنتجة	١	٢	٣	٤	٥	٦	٧	٨	٩
Radici Tessiture S.p.A. Via Pezzoli d'Albertoni, 37, I-24026 Leffe									
Ratti Donna Div. of Ratti Spa. Via Cernobbio 11, I-22100 Como									
Ratti 7, Div. Ratti S.p.A., Villa Sucota, I-22100 Como									
Ricamificio Automatico S.P.A., Via Ricamificio 46, I-370057 S. Giovanni Lupatoto-Ver.									
Romandecor Via Plinio, 9, I-22100 Como									●
Romi Srl. Via Acquanera 32, I-22100 Como									
Rosati S.p.A. Via Pistoiese 365, I-50047 Prato	●	●	●						
Samco S.R.L., Via L. Rigamonti 21, I-22020 San Fermo dell. Battaglia									
Sami S.R.L. Via Dante 13, I-22070 Bulgarograsso (CO)									
Ind. Tess. Sanesi S.p.A. P.O. Box 638, I-50047 Prato									
Lanificio Sangiovanni srl., Via Toscana 71, I-50047 Prato	●								
Scacchi Giuseppe S.p.A., P.za IV Novembre 1, I-22070 Solbiate Comasco	●								
Schwarzenbach Sud Italia S.p.A., Casella Postale 124, I-02100 Rieti									
Sea Point S.P.A. Idea Tessile Via Marazzone 4, I-22100 Como	●								
Sede Comm. Le Ed Via Meloni di Quartirolo 1, I-41012 Carpi -Modena-									
SEGALINI S.p.A., Via Poscastello n. 8, I-22047 Molteno/Como	●								
Selecta S.R.L. Via di Padule 30, I-50100 Sesto Fiorentino									
Setarium S.p.A. Via Roma 50, I-22060 Senna Comasco	●								
Seterie Cugnasca S.P.A. Via Rosales, 4, I-22100 Como									
SGAT Italia S.p.A., Via Provinciale 36, I-24040 Lallio/Bergamo	●	●	●	●	●				
Silanco S.p.A. Via Meloni di Quartirolo 1, I-41012 Carpi Mo									
Lan. Silvanese S.p.A. Viale F.lli Rosselli, 47, I-50049 Vaiano									
Sindalana-Ilva Via Pistoiese 132/138, I-50047 Prato									
Snia Fibre S.p.A., Via Friuli 55, I-20031 Cesano Maderno							●		
Soleris S.p.A. Via Melzo 12, I-20129 Milano									
Michele Solbiati, Sasil S.P.A. Via Garibaldi, 26, I-21015 Lonate Pozzolo	●								
Sopell S.R.L. Via F/lli Buricchi 25, I-50049 Vaiano — Firenze —	●								

Produktgruppen/ProductGroups/GroupesdeMerchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Stamperte Look S.p.A. Via San Gottardo No. 8. I-22079 Villaguardia									
Star — Stampa Tessuti, Artistici [illegible] ominioni 2, I-22070 Oltrona S. Mamette	●								
[illegible] S.A.S. di M. Giordano & C. Via Scalabrini 29, I-22100 Como	●								
STUCCHI, Adriano, S.P.A., Viale Geno 4, I-22100 COMO	●								
Studio Elle S.A.S. Via Diaz 38, I-22017 Menaggio (Como)	●								
Stura S.p.A. Via di Moschignano, I-50049 Vaiano									
Styletex Srl. Via Bocacchio 6/8, I-50047 Prato									
Tess. Taiana Virgilio Snc. Via Garducci 20, I-22077 Ogiate Comasco									
Tappeti Tempesti P.O. Box 622, I-50047 Prato									
T.E.C. SRL, Tessitura Elastici Circolari Via O. Respighi 273, I-41100 Modena									
Telene S.p.A., Str. Padana Superiore 53, I-20063 Cernusco sul Naviglio									
Terraneo Tessitura Serica S.R.L. Via Ronco, I-22074 Lomazzo (Como)									
Teseo Tessitura Serica de Olmeda Spa. Via Volta 53, I-22100 Como									
Lan. Teskid S.R.L. Via Semintendi, 2, I-50047 Prato	●								
Lan. Tesseriana Via Confini, 287, I-50010 Capalle Campi									
Tessil Brenta S.p.A. Fraz. Cares, I-38077 Ponte Arche (Trento)									
Lan. Tessilgodi S.p.A., Via Alfani 5, I-50043 Galciana/Prato									
Tessitura Serica Giovanni Canepa S.P.A. [illegible] inita 1, I-22020 S. Fermo Della Battaglia	●								
[illegible] ura Pratese S.p.A. Via Palarciano 51/57, I-50045 Montemurlo									
Tessitura Serica, Bedetti Pedraglio S.R.L. Via Volta 40, I-22100 Como	●								
Tessiture Italiane Riunite Srl. Via Grandi, 10, I-22100 Como									
Texapel S.p.A. Via Parugiano, I-50045 Montemurlo									
Texmantova S.P.A. V. le Forlanini 39, I-20024 Garbagnate Milanese									
Man. Texmeta S.R.L. Via Scarpettini 316, I-50040 Oste/Montemurlo									
Tiesseti Moda Srl. Via T. Grossi 8a, I-22100 Como									
Torello Viera Via Molin Gros, 10, I-Strona									
Toscana Jersey s.r.l. Via Scarpettini 318, I-50045 Montemurlo	●								

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Toscana Tricot S.p.A. Via A. Boito 15/17, I-50040 Montemurlo FI									
Tosco Laniera S.p.A. Via Labriola 231, I-50045 Montemurlo	●								
Tosco Line Srl. Via della Robbia, 27, I-50045 Montemurlo FI									
T.J.S.S. Srl. Via Cadoerna, 22, I-22100 Como									
Vartess Srl. Via Adua 10, I-20045 Gazzada Schianno									
Vasino di Angelo Vasino & C. S.A.S. Via Pierini Fontana, 1, I-10021 Cambiano (TO)									
Verga, Luigi, Tessitura & Stamperia, S.p.A. Via Volta 54, I-22100 Como	●								
Vibertess snc. Via Petrarca 7, I-22100 Como	●								
Set. Galetti Vittorio Via XX Settembre 7, I-22100 Como									
Zanfi Editori S.R.L. Via Ganaceto 121, I-41100 Modena									
Fratelli Zibetti S.p.A. Via Andrea Doria 9/11, I-21013 Gallarate									

Japan — Japan — Japon
Giappone
日本
اليابان

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Bizen Lace Co. Ltd. 1-7-28 Hana, Okayama-City									
Chodai Co. Ltd. 1-10-17, Sakae, Ichinomiya-shi, J-Aichi Pref.									
Chuetsu Lace Co. Ltd. 25 72 Suginoki, J-Tonami-City, Toyama-Pref.									
Dai-Ichi Lace Mfg. Co. Ltd. No. 15 Kisshoin Ochiai Cho, Minami-Ku, Kyoto					●				
Daido Orimono Co., Ltd. Showa-machi, Takehana, Hashima-shi, J-Giju Pref									
Design Plaza Max Ltd. Koga Building, 2-65-3, Bingomachi Higashi-Ku, J-Osaka 541									●
Fuji Flower Co., Ltd. Muromachi Takoyakushi Nakagyo-Ku, Kyoto 604									
Goda Embroidery Co. Ltd. 4-11-34 Matsuzaki-Cho J-Osaka 545 Abeno-Ku									
Hashimoto Woollen Mills 3-4-22, Sen-i, Ichinomiya, J-Aichi Pref.									

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Hayazen Orimono Co., Ltd. 44, Aza-Kazete, Oku-cho, Ichinomiya-shi, J-Aichi Pref.									
bu Keori Co. Ltd. Iiyamae, Konobunakajima, Bisai, J-Aichi Pref.									
International Wool Secretariat Japan Branch P.O. Box 608 Central, J-Tokyo									
Iwanaka Men's Co., Ltd. Showa-machi, Takehana-cho Hashina-shi, J-Gifu Pref.									
Iwanaka Woollen Co., Ltd. Takhena-cho, Hashima-shi, J-Gifu Pref.									
Japan Embroidery Lace Man. Ass. 9-18 Hinza, 3-Chome, Chuo-Ku, J-Tokyo									
Japan Wool Textile Group 21, Aza Hachinishi Kazeta, J-Ichinomiya City	●								
Kanebo Ltd., 2-2 Umeda 1-Chome, Kita-Ku, Osaka 530	●	●							
Kitana Keori Co., Ltd. 40, Kaminuma, Mishihagiwara, Bisai-chi, J-Aichi Pref.									
Kurabo Industries Ltd. 2-41, Kita-kyutaro-machi, Higashi-ku, J-Osaka									
Kuraray Co. Ltd. 12-39, Umeda, I-Come Kita-Ku, Osaka T 530									
Longchamp Co. Ltd., 11-1, Otsuka Kitamizo-Cho, Kyoto 607	●								
Marubeni Corporation C.P.O. 1000, Higashi, Osaka	●								
Mitsuboshi Worsted Mills, 15th, Aza-araki, Nabiki, Ymamto-cho, Ichinomiya-shi, J-Aichi Pref.									
Nakaden Textiles Co. Ltd. 1688, Aza-Gounainishi, Sanjo, Bisai-shi, J-Aichi Pref.									
Nippon Lace Co. Ltd. 114, Nakagomonnishi-machi, Nakakyo-Ku, J-Kyoto									
Nishiki Keori Co., Ltd. E[illegible]nashi, Kisogawa-cho, Haguri-gun, J-Aichi Pref.									
N[illegible]en Woolen Textile Co. Ltd. 63, Sande, Oku-cho, Ichinomiya-shi, J-Aichi Pref.									
Nomurasangyo Co. Ltd 39, Nabiki, Yamato-cho, Ichinomiya-shi, J-Aichi Pref.									
Okajima Sen-I Co. Ltd. 20, Niyanishi, Aza-kaimei, Bisai-shi, J-Aichi Pref.									
Osaka Senken Ltd. 4-4 Bingomachi, Higashi-Ku 541, Osaka									
Ryu Yamanoto 84-2 Bessho Misasagi Yamashina Kyoto 607									●
S and S 55 Sakurai-Cho, Kamigano Kita-Ku, J-Kyoto 603									●
Saibo Co. Ltd. 1-2 Nihonbeshi, Ningyo-cho, Chuo-Ku, J-Tokyo									
Sakai Lace Co. Ltd. 3-7-2 Nishiki-cho, Kanda Chigoda-Ku, J-Tokyo									
Sankyo Seiko Co. Ltd. 3, 3-Chome, Azuchimachi, Osaka	●								

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Senken-Shibum Co. Ltd. 3-8, Kayaba-Cho, Nihanbashi Chuo, J-Tokyo									
Shinko Sangyo Co. Ltd. 38, 2-Chome Kitakyutaro-Machi, J-Osaka 541									
Suzuken Keori Co. Ltd. 23, Aza-higashiukaiwake, Konobunakajima, Bisai-shi, J-Aichi Pref.									
Takashi Sakai International, Inc. Hamamura Bldg. 415, Muromachi-Takoyakushi Nagoya-Ku, J-Kyoto 604									●
Teijin Ltd. 11, Minami-Honmachi 1-Chome, Osaka, 541	●	●					●		
TORAY INDUSTRIES, Inc., 3-3, Nakanoshima 3-Chome, Kita-ku, Osaka, 530 Japan									
Toyo Lace Co. Ltd. 600, Kojima, Yonagida-Cho, Kurashiki-City, J-Okayama-Pref.									
Toyobo Co. Ltd., 2-8, Dojima Hama 2-Chome, Kita-Ku, Osaka 530	●	●							
Unitika Ltd. 4–68, Kitakyutaro-Machihigashi-KU, Osaka							●		
Wataroku Woolen Co. Ltd. 1552, Nagama, Kaminaka-cho, Hashima-shi, J-Gifu Pref.									
Watama Keori Co. Ltd. 22, Den, Sanjo, Bisai-shi, J-Aichi Pref.									
Yagi Tsusho Ltd. 20, Imabashi Sanchome, Higashiku, J-Osaka	●								
Yamacho Co. Ltd. 21, Aza-hachinishi-kazeta, Oku-cho, Ichinomiya-shi, J-Aichi Pref.									
Yoshichu Co. Ltd. 2–3 Nihonbashi-Honcho, Chuo-Ku, Tokyo	●								
Yoshitami Keori Co. Ltd. 18, Aza-gouminami, Konobunakajiama, Bisai-shi, J-Aichi Pref.		●							

Jugoslawien — Yugoslavia — Yougoslavie

ユーゴスラビア

يوغسلافيا

Centrotextil-Beograd Knez Mihailova 1–3, YU-11000 Beograd									
MTT Maribor Kraljevica Marka, 19, JU-62000 Maribor									
Novoteks Foersterjeva 10, YU-6800 Novo Mesto									

Produktgruppen/Product Groups/Groupes de Merchandises	1	2	3	4	5	6	7	8	9
製品区分 مجموعة الدول المنتجه	١	٢	٣	٤	٥	٦	٧	٨	٩
Tekstilna Industrija Textilindus Gorenjesavska 12, YU-64000 Kranj									
Unitex Cesta 81, YU-61001 Ljubljana									
V. .aks-Vartimpeks Marsala Tita 94, YU-42000 Varazdin									
Kanada — Canada — Canada **Canadà** カナダ كندا									
Hamil Textiles Ltd. 720 King St. West, CDN-Toronto Ont. M5V 2T3									
Korea — Corea — Corée 大韓民国 كوريا									
Kolon Industries Inc. Box 1052, Seoul									
S. g IL Industrial Co. Ltd. C.P.O.Box 2065, Sungpuk-Ku, Seoul, Korea									
Sunkyong Ltd. 5-3, 2-Ka Namdaemoon-Ro, Chung-Ku, Seoul	●								
Malaysia — Malaysia — Malaysia									
PENFABRIC Sdn. Berhad, Plot 117-119 & 200-202, Prai Free Trade Zone, Prai P.W., Penang/Malaysia									
PENTLEY Sdn. Bhd., Bayan Lepas Free Trade **Zone 3, Penang/Malaysia**									

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Niederlande — Netherlands — Pays-Bas — Paesi Bassi オランダ هولندا									
Bontex B.V. P.O. Box 288, NL-7500 AG Enschede									
Dentex B.V. P.O. Box 2, NL-2150 AA Nieuw Vennep						●			
Furtex B.V. Dr. Stamstraat 71a, NL-7534 CK Enschede									
I. F. T. B.V. Beversestraat 10, NL-5431 AD Cuyk	●								
Instant Fashion Postfach 51, NL-7500 AB Enschede									
International Textiles B.V. Keizersgracht 560 – 562, NL-1017 EM Amsterdam									
Itex B.V. De Langkamp 4, NL-3961 MS Wijk									
Jersey Trend Prints BV Postfach 220, NL-AE Almelo									
KIO (Kring Industriele Ontwerpers) Postfach 290 03, NL-3001 GA Rotterdam									●
Limbutex B.V. Punterweg 41, NL-6222 NW Maastricht									
Teddy Bont, NL-Oldenzaal									
Ten Cate Fashion Fabrics B.V. P.O.B. 58, NL-7600 GD Almelo									
Ten Cate Shirt Fabrics P.O. Box 58, NL-7600 GD Almelo									
Tricot en Jersey Fabr. Wed. J. van den Berg en Zonen B.V., Postbus 8, NL-1270 AA Huizen									
Vlaanderen Textiles B.V., Postbus 717, NL-7533 BM Enschede									
Vlisco B.V. Bouboudima Postfach 21, NL-5700 MA Helmond									
Wevex Nederland B.V. Postfach 7 40, NL-7500 AS Enschede									
Wisselink's Textielfabrieken B.V. Postfach 1, NL-7120 AA Aalten									
Österreich — Austria — Autriche Austria オーストリア النمسا									
Kurt Bartl Ges. mbH Heinzenbeer 43, A-6850 Dornbirn									
Antex E. Heinzle KG Giesingerstr. 8, A-6844 Altach	●		●		●				

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Blaas Textilwerke GmbH Postfach 68, A-9560 Feldkirch									
P[illegible]hi, Walter, Rheinstr. 10, A-6890 Lustenau						●			
t Bösch KG ostfach 15, A-6890 Lustenau									
Textil-Bösch, H. Bösch + Co. Dammstr. 12 + 12a, A-6890 Lustenau	●		●		●	●			
Bordada Stickereiges. mbH & Co. KG Augartenstr. 10, A-6890 Lustenau									
Brüschweiler GmbH & Co. Postfach 10, A-6890 Lustenau					●				
Ebensee AG, Spinnerei und Weberei A-4802 Ebensee/O.Ö.									
ERNEX August Erne Ges. mbH & Co. KG Postfach 135, A-6890 Lustenau	●		●		●	●			
Eybl, Karl, GmbH Industriegebiet, A-3500 Krems	●	●	●	●	●				
M. Faber & Co. Postach 49, A-1107 Wien						●			
Fend, Hermann, K.G. Postfach 142, A-6845 Hohenems	●				●	●			
Fildan, Ing. Gerhard, Ges. mbH Dr. Körner-Str. 64, A-2521 Trumau									
J. M. Fussenegger, Postfach 97, A-6850 Dornbirn	●	●							
Getzner Textil AG, Postfach 81, A-6700 Bludenz									
Hämmerle, F. M. Postfach 2, A-6850 Dornbirn	●	●	●						
Hämmerle, Richard Erlauerstr. 47 – 49, A-1233 Wien				●					
Hämmerle & Vogel KG., Brändlestr. 19, A-6890 Lustenau/Vlbg.	●		●		●	●			
Hoferhecht Stickereien, Dr. J. Hofer GmbH + Co. KG, ach 180, A-6890 Lustenau	●		●		●				
u Holzer GmbH & Co., Bündtenstr. 6A, A-6973 Höchst/Vlbg.									
Karl Hudatzky Fashion + Consulting POB 188, A-6800 Feldkirch									●
Kleinsorg AG & Co. Postfach 116, A-6890 Lustenau	●	●							
Kufner Textilwerke Ges.mbH, Sandgasse 94, A-8741 Weisskirchen									
Lace & Textil Ges.mbH & Co. KG Postfach 131, A-6890 Lustenau									
Längle, Gebr., Wirkwaren- und Stickereifabrik, Schweizerstr., A-6844 Altach/Vlbg.	●				●				
Daniel Metzler's Erben Postfach 8, A-6822 Satteins									
Walter Natter Ges. mbH & Co. KG Postfach 48, A-6890 Lustenau									
Otten, Josef, GmbH + Co. Kaiser-Franz-Josef-Str. 130, A-6845 Hohenems	●	●							

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجة	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Petex Textilhandelsges. mbH & Co. KG Schillerstr. 24, A-6890 Lustenau									
Pottendorfer Textilwerke GmbH, Fabriksgasse 15, A-2603 Felixdorf	●	●							
Rhomberg, Franz M., Textilwerke, Postfach 6, A-6850 Dornbirn/Vlbg.	●	●	●						
Textildruckerei A. Rueff GmbH, A-6832 Muntlix 184	●								
Sannwald GmbH Postfach 165, A-6901 Bregenz									
Scheffknecht, Isidor, & Co., Postfach 50, A-6890 Lustenau	●				●				
Schielseide AG Postfach 163, A-1061 Wien	●								
Schwenninger Ges. mbH & Co. KG Postfach 210, A-6890 Lustenau									
J. G. Seewald, GmbH + Co. KG Teilenstr. 3–4, A-6890 Lustenau	●		●		●	●			
Seidenweberei Silz AG, Postfach 163, A-1061 Wien									
Seidra Textilwerke GmbH, Salzgries 13, A-1010 Wien	●	●							
Stapf, Martin Ges. mbH Auwerk 21, A-6460 Imst	●								
Tiroler Loden AG General-Eccher-Str. 3, A-6020 Innsbruck									
Otto Vetter GmbH & Co. Loretoweg 14, A-6890 Lustenau									
Weberlace Weber GmbH Postfach 49, A-6844 Altach						●			

Peru — Peru — Pérou
Perù

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بيرو

Fab. de Tejidos La Union Ltda. S.A. P.O. Box 20 66, PE-Lima 10									
Instituto de Comercio Exterior Foreign Trade Institute P.O. Box 3545, PE-Lima 18									

Polen — Poland — Pologne
Polonia

ポーランド

بولندا

Textilimpex GmbH, Traugutta str. 25, PL-90950 Lodz	●	●	●						

Produktgruppen/Product Groups/Groupes de Merchandises	1	2	3	4	5	6	7	8	9
製品区分 مجموعة الدول المنتجه	١	٢	٣	٤	٥	٦	٧	٨	٩
Portugal — Portugal — Portugal Portogallo ・トガル البرتغال									
Altatextil — Ind. Textil Lda. Rua des Gens 3127, P-4450 Matosinha									
Fernandes Antunnes + Cie Lda. Apartado 3, P-3280 Castanheira de Pera									
Fernando da Silva Antunes + Filhos Lda. Apartado 87, P-6201 Covilha									
ARCO — Empresa Industrial de Santo Tirso, Qua Candido dos Reis 104, P-4000 Porto	●	●					●		
Sedas Aviz Rua Eng. Ferreira Dias 1173/77, P-4100 Porto									
Fabrica Baros Lda. Av. Infante d. Henrique 331 – 331a, P-1899 Lisboa Codex									
Exportugal, P.O. Box 19, P-2925 Azeitao									
Fabrica de Fiacao e Tecidos da Ponte da Pedra LDA. Rua Godinho de Faria 1499, P-4466 S. Mamede de Infesta Codex							●		
Fabrica de Tecidos Lionesa, Sarl. P.O. Box 5, P-4466 S. Mamede de Infesta Codex	●								
Faela Apartado 121 Lavadores, P-4402 Vila Nova de Gaia									
Francisco Fino Lda Apartado 6, P-7301 Portalegre	●								
Fisel Fiaco Estela de Seia Lda., P-6271 Seia Codex									
Flor do Campo (Soc. Textil a Flor do Campo, Sarl) Apartado 1- P-4780 Santo Tirso									
Manuel Goncalves sarl. P.O. Box 14, P-4761 Villa Nova de Famalicao	●	●	●		●				
-Instituto do Comercio Externo , de Outbro, 101, P-1000 Lisboa									
Martinho Apartado 1, P-6270 Seia Codex									
Mondorel, P.O. Box 222, P-3003 Coimbra Codex		●							
Mindelo Sarl. Apartado 13 — Mindelo, P-4481 Vila do Condl									
Motetexti, Soc. Textil do Mogo Lda. P-4470 Lugar do Mogo -Vermoin- Moia									
Texteis Moura & Mattos s.a.r.l. Apartado 21, P-6205 Tortosendo									
Narciso Ferreira de Oliveira & Filhos Lda. Apartado 3, P-4481 Vila do Conde Coedex									
Ninafil — A. Pereira Nina jr. + Filhos Lda. P.O. Box 63-128, P-6201 Covilha Codex									
Paulo Oliveira Lda. Apartado 157, P-6202 Corilha									
A. Penteadora Sarl. P-6215 Unhais da Serra									

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
RIOPELE, Fábrica Textil Riopele, S.A.R.L., Pousada de Saramagos, P-4760 V.N. Famalicao	●	●	●						
Sociedade Textil a Flor do Campo, Sarl. Apartado 1, P-4780 Santo Tirso									
Sociedade Textil de Baiona Lda. Caldas de Vizela, P-4800 Guimaraes	●								
Somelos sarl., B.P. 52, P-4801 Guimaraes Codex	●	●		●			●		
Tirsex Apartado 1, P-4781 Santo Tirso Codex									
Fabrica Textil de Vizela LDA. Apartado 24, P-4816 Caldas de Vizela									
Philippinen — Philippines — Philippines									
Dressmasters Corp. McPo Box 16 72, RP-Makati, Metro Manila									
Schweden — Sweden — Suède Svezia スウェーデン السويد									
AB Fodervävnader Box 165, S-50104 Boras	●								
Schweiz — Switzerland — Suisse Svizzera スイス سويسرا									
AARE AG., Steinzelstr., CH-5116 Schinznach — Bad						●			
Abraham AG Zöllikerstr. 226, CH-8034 Zürich									
Albrecht & Morgen A.G., Oberer Graben 44, CH-9001 St. Gallen	●	●							
Alfatextil AG, Talackerstr. 17, CH-8065 Zürich	●			●					

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Alfatrend AG Seestr. 30, CH-9326 Horn									●
TOCO A.G., onhardstr. 61, CH-9001 St. Gallen						●			
Baumlin AG, CH-9425 Thal									
Bischoff Textil AG Bogenstr. 9, CH-9001 St. Gallen	●		●		●	●			
BLEICHE AG., Postfach 125, CH-4800 Zofingen	●	●	●		●				
Brandenburger & Guggenheim, Inh. S. Guggenheim & Co., Postfach, CH-8023 Zürich	●								
Bromatex AG Postfach 33, CH-9475 Sevelen									
Camenzind & Co., Schappe-Spinnerei CH-6442 Gersau									
CWC Textil AG Hotzestr. 29, CH-8042 Zürich									
Dietfurt AG, CH-9606 Bütschwil									
EBS Ed. Bühler Spinnerei Stadthausstr. 39, CH-8402 Winterthur									
H. Ernst & Cie. AG, CH-4912 Aarwangen									
Christian Eschler AG, CH-9055 Bühler									
Eugster & Huber Textil AG, Teufenerstr. 3, CH-9001 St. Gallen	●	●	●						
Feinweberei Elmer AG, CH-8636 Wald									
Henry Ferber Ltd. Postfach 393, CH-9001 St. Gallen									
FILTEX AG, Teufenerstr. 1, CH-9001 St. Gallen	●	●	●		●				
Fischbacher, Christian, Co. AG Vadianstr. 6 – 8, CH-9001 St. Gallen									
Forster Willi & Co. AG, Flurhofstraße 150, CH-9001 St. Gallen	●	●	●		●				
Peter M. Gmuer AG Fürstenlandstr. 27, CH-9500 Wil	●					●			
mann & Cie. AG, CH-4914 Roggwil									
Habis Textil AG, CH-9230 Flawil									
Hasler Textil AG, Neugasse, CH-9442 Berneck				●					
Hausammann + Moos AG, CH-8484 Weisslingen	●	●	●	●	●				
F. Hefit & Co. AG, CH-8776 Hätzingen									
HGC, H. Gut & Co. AG, Postfach 923, CH-8039 Zürich	●	●	●						
Jaquenoud AG Teufenerstr. 2-4, CH-9001 St. Gallen	●	●	●						
Fritz & Caspar Jenny AG, CH-8866 Ziegelbrücke									
Willy Jenny AG Postfach 305, CH-9006 St. Gallen									
Paul T. Kamaras Postfach 342, CH-9001 St. Gallen									
Keller & Co. AG Wald, CH-8498 Gibswil									
W. Klingler AG, Wilerstr. 1, CH-9202 Gossau	●	●	●	●					

Produktgruppen/Product Groups/Groupes de Merchandises	1	2	3	4	5	6	7	8	9
製品区分 مجموعة الدول المنتجة	١	٢	٣	٤	٥	٦	٧	٨	٩
Lady's Lastic S.A., Teleckerstr. 17, CH-8065 Zürich					●				
Linea Elle Corso S. Gottardo 90, CH-6830 Chiasso									
Lang & Cie, CH-6260 Reiden									
Lior S.A. Postfach 33, CH-6862 Rancate	●								
Mettler & Co. AG, Postfach 995, CH-9001 St. Gallen	●	●	●						
R. Müller & Cie. AG, CH-5703 Seon									
NAEF, A., AG., Säntisstr. 9, CH-9230 Flawil – St. Gallen	●		●			●			
Nef & Co. AG, CH-9001 St. Gallen									
J. G. Nef-Nelo AG., Bahnhofstr. 4, CH-9100 Herisau	●	●							
Neidhart & Co. AG, Wattefabrik Stationsstr. 46, CH-8544 Rickenbach-Attikon	●	●							
Niederer & Co. AG, CH-9620 Lichtensteig									
Okutex AG St. Leonhardstr. 20, CH-9001 St. Gallen	●				●				
Rau & Co. AG., Rütihofstr. 1, CH-9052 Niederteufen						●			
Reichenbach & Co. AG., Postfach 761, CH-9001 St. Gallen	●	●							
Riba Seiden AG, Am Schanzengraben 15, CH-8039 Zürich	●								
Rohner, Jacob, AG., CH-9445 Rebstein/St. Gallen	●		●		●	●			
Rotofil AG Steinstraße 35, CH-8045 Zürich									
Schappe Kriens AG, CH-6010 Kriens									
Jak. Schlaepfer & Co. AG Teufenerstr. 11, CH-9001 St. Gallen									
Schoeller Textil AG, Luterbachstr. 1, CH-4552 Derendingen	●	●			●		●		
E. Schubiger & Cie AG, Obergasse 2, CH-8730 Uznach									
R. Schwarzenbach & Co. AG, Seestraße 185, CH-8800 Thalwil									
Schweiz. Gesellschaft für Tüllindustrie AG CH-9542 Münchwilen									
Spinnerei am Uznaberg, CH-8730 Uznach									
Spinnerei an der Lorze, CH-6340 Baar									
Spinnerei Streiff AG, CH-8607 Aathal									
Stehli Seiden AG, CH-8912 Obfelden	●								
Stoffels AG, Zentralverwaltung Fabrikstr., CH-8887 Mels	●	●							
Stotz & Co. AG Walchestraße 15, CH-8023 Zürich									
Studio M + M Design Michael Halid Dufourstr. 58, CH-9000 St. Gallen									●

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Studio La Moda W. + M. Gyr Via Quiete 13, CH-6900 Lugano									●
S[illegible] Textil AG [illegible]ich 669, CH-9001 St. Gallen									
S[illegible]zi Söhne AG Seidenstr. 22, CH-8853 Lachen	●								
Swiss Fabric Export Group Postfach 48 38, CH-8022 Zürich									
TACO AG, Feldeggstr. 5, CH-8152 Glattbrugg	●	●							
Trümpler & Söhne AG, CH-8610 Uster									
UNION AG., Postfach 315, CH-9000 St. Gallen	●		●		●				
Weber & Cie. AG, CH-4663 Aarburg									
Weberei Schläpfer AG, CH-9053 Teufen									
Weberei Tösstal AG, CH-8494 Bauma									
Weberei Walenstadt, CH-8880 Walenstadt									
Weberei Wängi AG, CH-9545 Wängi									
Weisbrod-Zürrer AG., CH-8915 Hausen a. A.	●	●	●		●				
Wetter & Co. AG, St. Gallerstr. 53, CH-9100 Herisau	●	●			●				
Wetuwa AG, CH-9001 St. Gallen									
Wild, Alwin, Tricotfabrik, Rheinstr. 31, CH-9430 St. Margrethen/SG	●	●	●						
Wiprächtiger AG Sägereistr. 17, CH-8153 Glattbrugg									
Wollweberei Rothrist AG, CH-4852 Rothrist									
Zieglertex, Dr. v. Ziegler & Co. CH-8065 Zürich									
Creations Willy Zuercher, Teufenerstr. 11, CH-9001 St. Gallen									

Spanien — Spain — Espagne
Spagna
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اسبانيا

Adimte Gran Via de les Corts Catalanes, 641 F-08010 Barcelona									●
Asotex S.A. Diputacion 248, E-08007 Barcelona									
Pascual Boada S.A. Girona 24, E-08010 Barcelona									
Catalana Internacional Textil S.A. — Cintex S.A. c/. Industria, 4-6, E-08130 Sta. Perpetua de Moguda									
Chamber of Commerce & Industry P.O. Box 119, E-Sabadell/Barcelona									
Cintex S.A. C/. Industria, 4 – 6, E-Sta. Perpetua de la Moguda									

Produktgruppen/Product Groups/Groupes de Merchandises	1	2	3	4	5	6	7	8	9
製品区分 مجموعة الدول المنتجه	١	٢	٣	٤	٥	٦	٧	٨	٩
Cisa Textil S.A. Tuset 3, E-08006 Barcelona	●								
Ferrer-Viladin Hijos de Jose Ferrer S.A. Bailen 5, E-Barcelona 10									
Garriga Hnos. Sucesor E-Sabadell									
Juenico Hermanos S.A., Fabregas 52, E-Esplugues de Llobregat/Barc.	●	●	●						
Lanitex, SA B.P. Box 107, E-Sabadell/Barcelona									
Malbor S.A. Caspe, 52, E-08010 Barcelona									
Nerpel S.A. Valencia 488, E-08013 Barcelona									
Man. Noguera Jorda S.A. Ausias March 61 – 63, E-08010 Barcelona									
Comercial Orillo Verde SA Ausias March, 7, E-08010 Barcelona									
Picancel Ferrer S.A. Bailen 22, E-Barcelona 10									
Pich Aguilera S.A., Lauria No. 21, E-Barcelona 10	●	●	●	●					
Jose Royo S.A. Castellon 2, E-Valencia 4									
Saintex S.A. Sol y Padris, 13, E-Sabadell (Barcelona)									
S.E.C.E.A., Gran Via 670, E-08010 Barcelona	●	●							
Sedagodon S.A. Ausias March, 6 y 8, E-08010 Barcelona									
Sederias Casber S.A. Ausias March, 9, E-08010 Barcelona									
La Industrial Sedera S.A. Bailen, 36, E-08010 Barcelona									
Sedunion S.A. Diputacion 280, E-08009 Barcelona									
Textil Clapes S.A. P.O. Box 45, E-Tarrasa									
Textil J. M. P.O. Box 179, Ctra. de Prats, Km 3,6, E-Sabadell									
Textil Santanderina S.A. E-Cabezon de la Sal (Santander)									

Südafrika – South Africa – Afrique du Sud
南アフリカ
جنوب افريقيا

Tongaat Textiles Ltd., D. Whitehead & Sons P.O. Box 3345, ZA-Durban 4000/Natal	●	●							

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Taiwan — Taiwan — Taiwan Taiwan الصين الوطنيه									
Oriental Knitting Co. Ltd. 108 Chung-Shan Rd. Yun-Chiu, Tainan Hsiang						●			
Thailand — Thailand — Thailande									
LUCKYTEX LTD., 8th Floor Rajadamri Arcade, 95 Rajadamri Road, Bangkok/Thailand									
Tschechoslowakei — Czechoslovakia Tchécoslovaquie — Cecoslovacchia チェコスロバキア تشيكوسلوفاكيا									
Centrotex AG Postfach 49, CS-14061 Praha 4	●								
Türkei — Turkey — Turquie Turchia トルコ تركيا									
AK-PA Tekstil Ihracat Pazarlama A.S. Miralay Sefik Bey Sok. Ak-Han 15, TR-Gumussuyu-Istanbul									
Akin Tekstil A.S. Girpici Veli Efendi Yolu 49, TR-Bakirköy-Istanbul									
Altinyildiz Mensucat A.S. Köyiati Mevkii Bakirköy, TR-Istanbul									

Produktgruppen/Product Groups/Groupes de Merchandises 製品区分 مجموعة الدول المنتجه	1 ١	2 ٢	3 ٣	4 ٤	5 ٥	6 ٦	7 ٧	8 ٨	9 ٩
Cukurova Sanayi Isletmeleri T.A.S. Adano Yolu Üzeri No. 157, TR-Tarsus									
Exsa Export Sanayi, P. K. 60, Adana	●	●	●				●		
Sümerbank Ulus Meydani 2, Ankara									
Tac Sanayi ve Ticaret A.S. P.O. Box 548, Izmir/Türkei	●								

UdSSR — USSR — URSS

V/O Exportljon
Street 33, Ul. Arkhitektor. Vlasova,
SU-117393 Moscow

Ungarn — Hungary — Hongrie — Ungheria

ハンガリー

المجر

Hungarotex,
P.O. Box 100, H-1804 Budapest Szep. U. 2

USA

アメリカ合衆国

امريكا

Siehe, Amerika, Vereinigte Staaten von

Dr. Drew. Thank you, Congressman Brown.

I am appearing here today as a representative of the Institute of Electrical and Electronics Engineers. I think we are generally well known to this Committee. I would remind you that we are the world's largest technical professional society.

Mr. Brown. The world's best.

Dr. Drew. I would certainly second that.

The subject of this hearing that we are addressing, national competitiveness, and certainly implied with that, the health and strength of our national science and technology enterprise is one that we felt very strongly about for a number of years and we are particularly pleased that you again brought a focus on this, in the context of a very major issue, which is being appreciated more and more by a larger segment of society.

I hope that as a consequence we will be building enough concern to be able to take constructive action. The U.S. has a practice of not being willing to take science and technology initiatives without a sense of "crisis" on our hands. It's regrettable but I think perhaps the positive side of the current crisis in national competitiveness will have the effect of stimulating positive action.

I am also, because of my previous background, someone who has dealt with the policy process in the White House for approximately 11 years under numerous Presidents and Science Advisors and in quite different settings, positive and not so positive. I am very skeptical about proposals for new institutional arrangements and what great things they might accomplish.

Therefore, in this context, I'm here to report that the IEEE is endorsing in principle the two bills that you have introduced, National Policy and Technology Foundation and the Department of Science and Technology.

I'd like to approach and summarize a few high points of my written statement to emphasize some of the more significant points, if I may.

First of all, I could not have given a better description of the importance of the issue and some of the background that Dr. Rosenstein has this morning. I think that is an absolutely excellent introduction to the reasons why we need to take some action.

There is a question now, what is the appropriate Government role in dealing with that action and then assuming that one is convinced there is a Government role, are the proposals going to be implemented, can they really pull off the kind of solutions that we would like to see.

I believe that the climate is right for a new institutional setting in which we can pull together some of the various pieces of what we call technology policy and technology policy implementation under the Federal Government's sponsorship.

Actually, I would like to have some clarion call for a new era in which Government/industry cooperation in dealing with technology and its application could come about. Frankly, I think what we need and I hope we will develop in the course of your Committee's review of technology policy over the next months, is something comparable to Vannevar Bush's "Science, the Endless Frontier," because I think it is desperately needed. This measure and some of your other measures I think are the building blocks on which I would hope that new vision can emerge.

I'm less skeptical about the institutional aspects of this than I have been previously. I think you have to ask yourself, are there existing institutions in which a stronger focus can be in place that will do much of the same thing. I think a look at past experience can be very informative. It turns out that I have a certain institutional memory.

I can remember things that the representative from the Department of Commerce didn't remember this morning about the Bayh-Dole bill which opened up to small businesses exclusive licenses of Federal technology. In fact, our firm uses that and did use it years ago to gain access to Federal technology on an exclusive basis.

I can go back before that to times when we put the RANN program, Research Applied to National Needs in the NSF, where Stevenson-Wydler was an attempt to put something in the Department of Commerce, where in fact even before that there was a civil technology program that was supposed to be appended to the Department of Defense. We have tried to do this before. We have tried to stimulate things in existing Government agencies. Frankly, it hasn't worked very well. I think it's a very reasonable thing to say, let's look at a new institutional structure, let's see if we can define a suitable operational role for it.

In this context, therefore, there are a couple of reminders. One thing, I think you have to bring together a body of operational programs. That means they have to be spending money, if you really look at it, they have to be able to spend money to cause things to happen. They can't be just a policy office sitting somewhere. That's a defect in OSTP. It's a defect in a lot of institutional structures that have been proposed before. It has to have genuine operational responsibility and delivery mechanisms.

Therefore, the proposal has some very good features. It brings the National Bureau of Standards into a somewhat different setting. That's a body that could be expanded significantly. We have testified in favor of that. It brings up patents. Maybe yes; maybe no, in that area. It brings industry/university cooperative R&D centers, the engineering directorate. These are all part of what I think are essential to any new institutional structure, and that is a body of operational program activities that is generally consistent. Frankly, I think these are. It does have the other positive aspect and that is a point that was made earlier. Right now, when you look at new initiatives and the IEEE has been working on a strategic materials initiative, materials in this case in the semiconductor field, for a couple of years. We looked to emplace this and we found DOD was the only really logical and vigorous agency that was an appropriate place to try and accomplish this work.

With your permission, Mr. Chairman, I would like to enter a paper on the IEEE strategic materials initiative describing that and some of its objectives, as an example of a program that might fit in your foundation as well as perhaps in the DOD.

Mr. Brown. Without objection, that will be made a part of your statement.

[The information referred to follows:]

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BRIEFING PAPER ON THE STRATEGIC MATERIALS INITIATIVE

Concept Definition: The Strategic Materials Initiative

Synthesis of advanced electronic materials, and the equipment to process them, require highly sophisticated and expensive research and development personnel and facilities. Due to very specific applications of particular materials and equipment, in meeting either defense mission needs or the currently small but growing commercial demand, the markets for these "niche" materials and equipment are now too small to support the necessary R&D base at each individual company. Foreign suppliers, typified by large, vertically integrated corporations and/or government coordinated R&D, now dominate these markets. Specifically with regard to defense requirements, the recently released report of the Defense Science Board Task Force on "Semiconductor Dependency" issued the following as a central finding:

> "The extent of dependency of defense systems that are now in the field on foreign seminconductors is difficult to determine, but evidence indicates that in the newest systems about to be deployed a significant fraction of chips used - up to several tens of percent - are either entirely made, or packaged and tested, abroad. If steps are not now taken to assure availability of domestic sources or stockpiles, or both, the U.S. could be denied timely access to these militarily critical devices in wartime or...forced to rely on technologically and operationally inferior alternatives."

Over the past two years, both the Institute of Electrical and Electronics Engineers, Inc., and the Materials Research Council of the Defense Advanced Research Projects Agency (DARPA) conducted studies addressing the lack of domestic sources for the advanced materials used in sophisticated military electronics systems. As a result, the two groups independently recommended the establishment of Industrially-managed Centers of Excellence to address four specific electronics materials areas; Optoelectronics, Advanced Bulk Crystal Growth, Artificially Structured Layered Growth, and Materials Influence on Silicon Integrated Circuit Processing. There was a recognition by both groups that regardless of specific technology thrust, the need exists for an innovative R&D management effort to accelerate the pace of developing these critical technologies and rapidly transfer that technology to the domestic producers of semiconductor materials, devices and manufacturing equipment.

This concept of multiple Industrially-managed Centers of Excellence in semiconductor materials has been advanced over the past year within the Department of Defense under the banner of the Strategic Materials Initiative. We are pleased that the Defense Science Board Task Force Report, under Recommendation Three, notes:

> "In addition, support for the Strategic Materials Initiative now being considered by the DoD is recommended. This focus on a broad range of materials opportunities is complementary to proposals made herein."

Concept Implementation:
The Compound Semiconductor Materials Intitiative:
The U.S. Laboratory for Optoelectronic Materials

As a prototype, the two groups recommend the establishment of one center addressing Compound Semiconductor Materials, with Optoelectronics as its thrust. The Laboratory for Optoelectronic Materials, envisioned to last five to seven years, would be supported by funding from private corporate contributions of capital, equipment and personnel, and funding directly from the Defense Department. This experiment in innovative R&D management would be a logical function of the Defense Advanced Research Projects Agency. The total cost of the prototype effort is gauged to be $125 Million. It would be governed by a Steering Board of industrial, government and university participants, and managed as a non-profit institution by a full time staff.

The Laboratory is envisioned to provide a critical mass of funding to overcome significant technology hurdles, and an innovative relationship between the industrial, university and government research communities that would enable broad crossfertilization of research and development output. It is expected that the consortia of interests would enable pursuit of a longer-term, larger scale research effort than any of the participants could launch on their own, thus enabling a fortification of our domestic technology base.

Corporate Team members would benefit from early access and advantageous patent rights on the results of the research and development output. By requiring the participating companies to make a significant financial and personnel investment in the project, and assume the associated risk, it is anticipated that they would manage the Laboratory with greater diligence than they would a risk-free venture. The operation of the Laboratory would be geared toward rapid technology transfer to industry on a real-time basis over the life of the effort, rather than expecting such transfer to occur at its conclusion.

Defense Department funding would ensure that the focus of the research and development effort was consistent with the defense mission needs of the nation. It is recommended that full government funding be appropriated at the outset, with obligatory authority extending over the life of the project, to assure industrial investors that the government's commitment will not be annually revisited with the potential of premature termination at a later date.

The involvement of Universities, the National and Triservice Laboratories, as well as small businesses, materials and equipment manufacturers, would permit timely transfer of advanced technology to these vital sectors. It is understood that only U.S. corporations and nationals would be permited to be involved with the project in an effort to ensure reduced opportunity for transfer of the resulting technology overseas.

Several similar consortia have been intitiated in the past few years, including the Microelectronics and Computer Consortium (MCC), the Semiconductor Research Consortium (SRC), and the recently announced Semiconductor Manufacturing Technology (SEMATECH) program. None of these efforts were designed to fill the key research need intended by the Strategic Materials Initiative. While the purpose and technology thrust of these other consortia should not be confused with that of the Laboratory for Optoelectronic Materials, they do provide several baseline models by which to construct the Laboratory to enable protection of participants from anti-trust concerns, as well as formulae for handling patent rights on resulting innovations.

Research and Development Focus

Optoelectronics is a broad category of electronic components that includes: Light Emitting Diods (LEDs), used in large numbers for displays and indicator lights in consumer electronics; infrared LED's used as sensing devices such as camera autofinders; and visible Laser Diodes (LDs) used in compact disks. Also, both infrared LEDs and visible LDs are used in optical fiber communications systems, a market that will explode in the coming years. Optical computers might well be developed during the next decade that will partially depend on the technology base developed through this program.

The goal of the Laboratory would be to creat a new class of devices integrating optical and electrical components onto a single chip. Such devices are fabricated from compound materials of the Groups III and V elements, such as gallium arsenide. A single optoelectronic integrated circuit (OEIC) could combine lasers, photodetectors, and electronics devices such as amplifiers and modulators, with much the same military and commerical impact as the "computer on a chip" of a generation ago.

Specific research targets would include:

Materials growth (Bulk, EPI)
    Gallium Arsenide, Indium Phosphides
    Heterostructures
    Heteroepitaxy

Advanced Processing and Characterization
    New Industry Tools

Advanced Demonstration Devices
    Gallium Arsenide on Silicon
    3 Dimensional Optoelectronic Integrated Circuits
    Microwave/optical combinations

Structure

The Laboratory is envisioned as a non-profit center, governed by a Steering Board that would be responsible for overseeing management of the facility and setting the agenda for research and development targets. Representation on the Steering Board would be as follows:

Corporate Team Members: There are envisioned to be about ten corporate team members. Each member would be responsible for contributing $1 Million annually in either direct funding support or equipment contributions. In addition, each Team Member would provide qualified technical management personnel who in turn would be expected to contribute a substantial amount of their time on site. By enabling some key personnel to maintain a part-time corporate presence and identity, it is hoped to improve the rapid transfer of technology back to participating companies, and improve the caliber of personnel devoted to the project by forestalling the breakdown of a sense of affiliation between the individuals and their respective corporate entities. Another key concept is the shared use of anlytical equipment by the participants, hence enabling a critical leverage over what each participant could accomplish on their own.

Government: DARPA would act as the government's contracting agent. The full cost of government participation would be about $75 Million, $25 Million for initial capitalization, and $10 million per year over the life of the project. It is recommended that full funding be appropriated with, and above, the FY 1988 budget request for DARPA, with obligatory authority ranging over the life of the project. DARPA would ensure that defense mission needs are addressed, and also would be responsible for overseeing administration of a program to enable rotational assignments to the facility by qualified researchers from the Triservice laboratories.

University Team Members: There are envisioned to be two universities on the Steering Board who would be selected on the basis of excellence in academic research capabilities and financial and faculty contributions. One major function of the University Team members would be to oversee administration of the academically focused elements of the Center, such as a university fellowship program and other mechanism to ensure active participation by U.S. nationals on faculty and in graduate programs at universities. Key amongst these would be to establish guidelines intended to promote technology transfer to the university community while restricting the flow of technology to foreign nationals at affiliated campuses.

National Laboratory Team Members: There are envisioned to be two National Laboratories on the Steering Board, possibly funded through the Office of Military Affairs within the Department of Energy. These members would ensure transfer of technology back to the National Laboratories, and would be responsible for overseeing administration of a program to enable rotational assignments to the facility by qualified National Laboratory researchers.

In addition to the principal participants, steps would be taken to enable more limited access to the facility by additional Domestic Corporate Subscribers. These would be Materials and Equipment Manufacturers, as well as other critical small businesses, the participation of which is consistent with the objectives of the center. Their degree of involvement and financial obligation, possibly based on a percentage of sales, would be negotiated by the Steering Board. Contributions by Domestic Corporate Subscribers could be made in direct funding, or contributions of equipment, tools, or materials.

Personnel Requirements

There is proposed to be a total of approximately 100 professionals working at the facility, along with additional support staff. In addition to the management technical personnel on-loan by industrial participants, as well as faculty, graduate and other researchers on-site from participating universities and other research centers, there will be the requirement for a more stable core of technical personnel employed directly by the Laboratory. The specific number, roles, as well as guidelines for such employment, would be the responsibility of the Steering Board.

Geographic Location

In order to reduce start-up costs and time, it is proposed to place the Center at an available existing facility.

Antitrust

Sufficient models exist to ensure that the Laboratory can be structured to provide maximum protection for participants against anti-trust concerns.

Patent Policy

Models exist to ensure appropriate patent incentives for corporations, as well as individuals, participating in research at the center.

Mr. Drew. Secondly, I think this institution must not be a fully internalized institution. It has to build on outside expertise. Policy development in this area should be utilizing the best brains in industry, not for profits and the academic community to focus on problems and not look at a fully internalized policy shop. I think the useful feature of the council concept does that and I like that and I think that is something that should be built upon. They need to be able to reach out and tap the best brains that they can to help solving what are very difficult problems.

Again, I would like, with your permission, introduce a paper on a similar proposal that was generated by a private group called the Technology Council of the U.S.A., which was built on very similar grounds and would have some things that would be useful for your staff to consider.

Mr. Brown. Without objection, it will be made a part of the record.

[Information to be furnished follows:]

DRAFT

DRAFT
DESCRIPTION
OF
THE TECHNOLOGY COUNCIL OF THE UNITED STATES

A NEW ORGANIZATION FOR THE PROMOTION OF INNOVATION AND CREATIVITY

#

A PRIVATE, NOT-FOR-PROFIT CORPORATION

THE TECHNOLOGY COUNCIL
OF THE
UNITED STATES

THIS IS A DESCRIPTION OF THE CHARACTER, ORGANIZATION, OBJECTIVES AND OPERATIONAL FEATURES OF A NEW INSTITUTION THAT IS BEING PROPOSED TO BRIDGE THE GAP BETWEEN GOVERNMENT AND INDUSTRY AND TO FOSTER PROGRESS IN THE BENEFICIAL USES OF TECHNOLOGY. WHAT FOLLOWS IS ILLUSTRATIVE, AND IS INTENDED TO PROMOTE DISCUSSION AND FURTHER REFINEMENT OF THIS CONCEPT.

WHAT IS THE TECHNOLOGY COUNCIL?

Basic purposes of the Council

The Technology Council of the United States is a private, not-for-profit organization, established to promote the development of an improved technology policy framework for the United States. The Council provides a forum for government and the private sector to consider common problems and build a consensus on policy and program initiatives that would advance the more effective application of technology to national needs. It will provide analyses of issues and will help to identify emerging problems involving technology and its application. In this regard, it is more than an association with a common set of interests. It will enlist a select group of distinguished professionals who will articulate the issues, provide thoughtful analyses, organize and lead discussion and debate on their content, review and refine the analyses, and publish these papers for use by government policy-makers, the public and industry as well as the Council. By establishing effective dialogue between the government and private sectors, the Council will strive to identify and solve major policy problems and influence public policy decisions on technological innovation.

Importance of developing and maintaining an analytical base for the Council's efforts

The Technology Council will provide a continuing focus on the process of innovation and will provide support and encouragement for measures that stimulate individual creativity and creative solutions to national problems. In this role, the Council will serve as a mechanism for bringing together the various parties interested in promoting these topics in the public policy domain. Membership will be open to all who share these objectives.

Privately, not publicly supported

The approach to be taken by the Council emphasizes private sector initiatives, both in providing the impetus for policy change and the vehicles for real technological progress.

WHY IS THE TECHNOLOGY COUNCIL NEEDED?

Increasing threats to U. S. technological leadership

The U. S. has experienced a decline in the rate of productivity growth, a lagging rate of innovation and increasing penetration of domestic markets by foreign competitors in many industries. Measures that may reverse these trends will require greater cooperative effort among the various interested and affected constituencies as well as greater clarity regarding the issues, the options for dealing with these issues, and the possible consequences of both action and inaction with respect to them.

Previous failures to establish a continuing mechanism for encouragement of technological innovation

The perception of the need to deal with the problems of technology development, productivity and innovation is not new. Almost 20 years ago a "Civilian Technology Panel" was convened by the President to examine the problems of technological innovation. This was followed by the work of a blue-ribbon panel of experts who published the 1967 report "Technological Innovation: Its Environment and Management". In 1972, there was a Presidential review of "New Technological Opportunities" and then in 1978-79, the President convened a Domestic Policy Review of industrial innovation. In each of these efforts, a multitude of recommendations were supplied to the Government and extensive analyses and commentary were developed - only to be received with interest and then become gradually lost in the press of other concerns. No continuing mechanism was established for keeping a focus on these issues, and this explains - in part - why it was necessary for each new Administration to conduct its own review of this area.

In commenting on this situation at a recent symposium on innovation and U. S. research, Mr. William Carey, Executive Officer of the American Association for the Advancement of Science made a powerful appeal for the creation of the mechanism that is being described in this document:*

> "There has to be a powerful and convinced advocate for a strong set of policy changes, particularly where these would require legislation or trigger public interest controversy. In turn, the best of advocates must be backed up by a strong and unified constituency because if anything is certain it is that opposition would be mounted by other constituencies which are both strong and unified... Big policy changes -- and they are all that matter, not futile tinkering at the fringes of the problem -- big policy changes call for very big effort, and

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*Innovation and U. S. Research, American Chemical Society, Washington, D.C., 1980 - Report of a Symposium at the ACS Meeting, September 1979.

> this means a majority coalition that won't split. It means a coalition of large and small industry, labor organizations, economists, professional groups, media, and elected representatives. It means a coalition that isn't simply slapped together for a couple of years of lobbying, but one that is well-grounded with information and one that can be sustained over the five to ten years that it would take to turn around the current situation and get the rate of innovation up to where we would like to see it..."
>
> "Meanwhile, there is a tremendous educational job to be done if the ground is to be prepared for sequential actions on behalf of innovation. The ground has not been well-prepared as of now. Almost nothing has been done to focus the problem of innovation and its constraints ... business and labor (should be) working together to inform and convince the public and the Congress that our economy, nationally and internationally, is going nowhere but downhill on all the present evidence of technological innovation, and that government and the market economy must work together while there may still be time.

No adequate institution exists today

The needs above will not be satisfied by simply re-directing existing institutions, forming another blue-ribbon task force or carrying out another Executive Branch review. There is a need for continuity, dedication to the purposes outlined above and elsewhere in this document, and stability that can only come from a private sector institution that is not subject to bureaucratic whim. It is important, in this regard, that there be a high degree of independence from government funding and support and that the Council be representative of interested segments of society, as well as a broad cross-section of industry interests.

Too narrow focus of existing groups and associations

Given these essential characteristics, it seems clear that existing industry associations for the most part are too narrowly based or are focused on other specific policy areas not easily extendable to the goals identified for the Council. Similarly, the National Research Council and its constituent bodies are strongly dependent upon government support and have been chartered for specific and different purposes than those described herein. The above objectives might be pursued, in an existing organization such as the American Association for the Advancement of Science. The AAAS has a broad charter, and is largely privately supported, but does not have the tax status that would permit the advocacy role that is anticipated for the Council. The AAAS also has a strong orientation toward basic science, an important mission but one that would tend to dilute the needed attention to technological affairs. A review of other possible institutions seems to indicate similar deficiencies between their roles and the needs identified herein. Thus, it appears that a new institution is needed -- the Technology Council.

WHAT PROGRAMS AND ACTIVITIES WOULD BE CARRIED OUT BY THE TECHNOLOGY COUNCIL?

Importance of a solid analytical base

The Council will develop, analyze, and, if appropriate, advocate policies that, inter alia, create a favorable climate for development of new technologies, facilitate technology transfer, promote technological innovation, improve both the quality and availability of technical manpower, support productivity improvement and generally improve and revitalize the technological enterprise of the United States. The specific policies and positions that are developed will be based upon a foundation of policy research and analysis, information and data gathering, consultation and review, and possibly active experimental validation. The intent is to produce a high quality, credible analytical base for the views that are expressed by the Council in its advocacy role.

Role of Advocate

The role of advocate will be carried out through a variety of means, including but not limited to:

- publication of position papers;
- conduct of workshops, symposia and conferences to focus attention on specific technology policy issues;
- presentation of briefings to Congressmen and Congressional staff;
- participation in Congressional hearings and development of testimony by members before the Congress;
- appearance before private groups, public meetings and other forums to build awareness of the issues and present Council recommendations; and
- development and presentation of data and views suitable for use by the printed and electronic media.

Summary Data on U. S. Technological Posture

The Council will also serve as a home for the analytical study and review of our national technological posture, assembling insofar as possible, a credible data base for use in such analyses. In carrying out this role, it is expected that the Council will:

- develop an information system accessible to interested subscribers and members that would include data on the various aspects of industrial innovation (patents, trade data, R&D expenditures, industrial productivity, foreign investment, etc.), legislative measures relevant to technology policy, productivity and innovation, and synopses of position papers and other references dealing with these subjects;

- publish periodic reports - presenting trends in important data; and
- provide one-year fellowships for the analysis of data and development of improved indicators in support of such analysis.

Importance of high quality Professional Staff

A key functional activity of the Council will be its support of public policy research in areas of interest to tHe Council as well as the development of Council positions using expert, full time staff and visiting resident study leaders. A crucial element in providing the degree of continuity of effort necessary to translate members views into effective public policy initiatives will be the presence of such individuals to provide leadership and follow-up. This staff resource will provide the organizational support for all of the policy activities of the Council, and as such will be the indispensable ingredient that makes the Council more than just another association of members with common purpose, but gives the Council extra strength, continuity and intellectual credibility to complement the collective work of its members.

Council will establish sophisticated information resource

Since information is the life blood of the Council, particular attention will be given to the technological sophistication and utility of the supporting information system. Among other things, the Council will maintain an electronic library and data bases, accessible to individual members on a marginal cost basis, which would include subscriptions to and analysis of a number of information banks, news services, Congressional and agency tracking services, scientific bibliographic and biographic services, etc. The Council will also maintain a computerized telephone communications network with members, both individual and corporate, to alter them to important information and opportunities. Timely communications would enhance their understanding of issues of concern and allow timely response. This network would also allow continuous computerized information gathering from its entire membership, as well as the ability to inform and interest the scientific community in the problems of S&T policy. The Council could develop and make its electronic conferencing network available at cost to its members.

The Technology Council would also sponsor a new publica-

A New Publication covering technology, engineering and other areas.

tion, possibly titled American Technology, that would serve as the centerpiece for communicating substantive information to members and the public-at-large. This would be designed to appeal to a broad cross-section of business executives, managers, engineers, scientists, policy-makers, and the general public interested in advanced technology rather than addressing a scholarly audience alone. As such, the latest photo journalism and publishing technology would be used to produce a high quality publication that provides strong images and visual insights on the modern world of technology. American Technology could include (a) feature articles on advances and achievements on the frontiers of technology and innovation; (b) research reports or white papers on economic and policy issues on technology innovation; (c) regular news features on new books, current events, new products and inventions; and (d) editorials on important current issues. The recent introduction of a number of popular science magazines is an indication of a significant and competitive market for this type of publication, but these also have a heavy focus on science leaving a noticeable gap in the coverage of technology, engineering and related policy issues. American Technology would help fill this gap in the public's understanding of the innovative process and provide a greater appreciation of the challenges, achievements, and contributions of modern technology to the nation.

Other Council Publications

As the Council matures and expands, its publications are expected to include: (1) a monthly newsletter reporting Council activities and important developments on the national or international scene relevant to the Council; (2) annual report of the Council including key summary indicators of the status of technological development; (3) selected papers or monographs on specific issues; (4) special analyses prepared from time-to-time with support from sponsoring members; (5) position papers stating the Council's views; (6) a journal that would include solicited and unsolicited refereed papers on topics appropriate to the interests of the Council; and (7) special purpose compilation or reading lists and reviews, statements, testimony presented to the Executive or Legislative Branch or other materials. Council products would typically be available in electronic or printed form, using best available technology, up-graded as practicable. In general, it is expected that these publications would keep track of all significant developments in S&T policy at the State and local level as well as in the Federal government.

The Council would issue news releases, as needed, on matters of S&T policy, would respond to requests for expert testimony, and would keep a data bank of scientist and technicians to serve as experts when needed by governmental or other approprite groups.

Other Benefits from Council Research Staff

As an example of the services that could be provided to members by the Council staff, a small legal and regulatory research group could monitor developments and impacts of new regulations on industrial innovation, perform special studies on deregulation, assess barriers to new innovations, and/or provide preliminary legal counsel, assistance, or referrals to member firms considering litigation on matters involving scientific or technical issues. The legal research staff would, of course, be specialized in the interface between science, technology and the law and provide a source of expertise not typically found in Washington, D.C. law firms. Thus, a legal and regulatory research capability could save member resources in early stages of legal actions. This and other research capabilities within the Council will provide not only a solid foundation for the Council's policy development efforts, but also a valuable resource for member firms.

PRODUCTS AND SERVICES

The following publications and services are illustrative of those envisioned for the fully mature Technology Council. They would be phased in as the staff and membership increases, with early priority given to member communications.

Typical Products (Available in Printed or electronic form)

- Magazine - American Technology
- Policy papers and reports (by Council Staff)
- Technology Policy Journal
- Council Seminar or Symposium Proceedings
- Annual Report and Assembly Record
- Periodic Legislative Reports and Issues Alerts
- New Releases
- Television and Radio Inputs on Technology

Examples of Services (To Members, and where noted to non-members on a fee-paying basis)

- Access to Council Data Bank (patents, trade data, R&D budgets, foreign investment, etc.) with electronic or printed output - available to non-members at an increased fee.
- Teleconferencing network - To members and non-members on a fee basis.
- Electronic Library - key sources and references in technology policy areas, status of legislation, etc.
- Resource bank/speakers bureau of experts available for consultation or appointment to Federal Positions or for public appearances - to members or non-members - no fee.
- Legal research and assistance on topics that are unique to the technology/legal/regulatory interface - to members on a fee basis.

Council-Sponsored Activities

- Annual Assembly and Workshops
- Seminars/Conferences/Symposia
- Prizes and Awards for Technology Contribution
- Computerized telephone communications network - used for information transfer to and from membership
- Research fellowship program (one year educational/research oriented appointments)

WHO MAY BECOME MEMBERS OF THE TECHNOLOGY COUNCIL?

Council should appeal to a broad constituency

The overall goal of the Council - to foster progress through promotion of innovation and creativity - would benefit people of every nation and at all economic levels. The initial emphasis will be on measures that focus strongly on the continuing growth and revitalization of the U.S. industrial sector. Because of the interconnected nature of the world economy and the dependence of much of the Western world upon a strong United States, both economically and militarily, the Technology Council program should be of interest to a very wide audience.

Membership

For practical reasons, however, the initial priorities for enlisting membership in the Council will emphasize institutional and individual participation from the United States. In general, membership will be open to all who share in the objectives of the Council. There are three types of membership: **Sponsoring Member, Member, and Associate Member.**

Each type of membership provides opportunities for active participation in promoting the beneficial development and application of new technology and the encouragement of policies that support this goal. Membership fees, which are structured to reflect the different types of members, will be related to the degree of participation in the Council Programs and will permit a relatively broad degree of flexibility of involvement.

Role of Sponsors

Sponsors will play a significant role in determining the policies of the Council through their election of, and special linkage with, the twelve members of the Governing Board that serve two years terms. Sponsoring membership will normally be on an institutional basis (profit-making or not-for-profit institutions) with fees set on the basis of a fraction of gross revenues with a maximum ceiling and minimum entry fee set by action of the Board. Individuals may become sponsoring members based upon the same fee schedule.

Members

Members, the majority of which are expected to be individuals, will receive the basic Council publications and may participate in the Annual Assembly of the Council, will elect the Chairman and Chairman-elect of the Governing Board as well as six at-large board members (who serve for one year terms), will be involved in the Council communications network (to the degree and depth of involvement they choose), and will have the opportunity of participating in other Council-sponsored activities at preferential fee schedules. The Annual Membership in the Council is expected to be about $65.00.

Associate Membership

Associate membership is available to students, senior citizens and specified other individuals or organizations. It will provide for participation in Council-sponsored events on the same basis as supporting members and will include distribution of the basic Council publications. Associate members do not vote for Board members or on other business matters that may be brought before the Assembly, and the fee schedule will be appropriately reduced (in the range of $30 annually).

WHAT ARE THE OPPORTUNITIES AND BENEFITS OF MEMBERSHIP IN THE COUNCIL?

Enabling an active membership involvement

Membership in the Council will enable active involvement in promoting the Council objectives, and toward this end, the participation in the Council Assembly and in the inter-member communications systems (described below) will provide both a unique opportunity and a special responsibility. The Council, through its information and assessment activities will alert members to opportunities to engage in active advocacy of measures to strengthen technological developments. The Council will provide the solid analysis of this advocacy role.

Access to state-of-the-art information through communications technology

All members will be entitled to receive publications of the Council as part of their membership fees and will be regularly informed regarding the nature of new materials that may become available, including position papers, testimony presented on behalf of the Council and related matters. The Council will make extensive use of communications to improve awareness of the importance of innovation and technology policy throughout government and an informed electorate. It is intended that state-of-the-art information management techniques and associated technology be used for internal and external communications, so that the Council will serve as a demonstration of technical progress as well as serve as an advocate.

Benefits

Several types of benefits would accrue to individual and corporate members as a result of services that could be performed by the Council including:

1. Access to effective or alternative **channels of influence** and participation in public policy debates on issues of vital interest to the membership;

2. **Improved overall climate for R&D** and innovation as a result of sustained efforts by the Council to improve public policies in these areas;

3. Timely **information on current government policy** developments, decisions, budgets, programs, regulations and other government activities that impact on business decision or technology innovation based on continuous scrutiny, systematic monitoring, and analyses of these areas by the Council's staff;

4. Access to **improved data resources**, analyses, and information developed by the Council's staff on technology innovation and change that can be used by members for R&D planning and management, technology

and market forecasting, and/or technology policy analysis and evaluation;

5. Potentially large dollar savings to individual members by pooling resources for routine data collection, monitoring current events, or other information services that could be performed by the Council staff that are now duplicated by or not available to members by other means;

6. Participation in the Council's Research Fellow Program would provide invaluable experience and exposure and training for senior and mid-level executives in public affairs and in complex national problems in science and technology policy under the guidance of the professional staff;

7. A large portion of members' contributions would be tax deductible and would be applied to a constructive and worthy cause; and

8. Members would receive publication recognition (if desirable) and generate goodwill by supporting an alternative source of information to the public and policy-makers on the importance and wise use of the nation's technological resources.

Helping members to become better informed

The Annual Assembly will provide a special forum during which a broad range of issues will be reviewed and member discussion and comment will be encouraged. The sessions will include an outline of the planned program for the next year as well as scheduled interactions with Congressional and Executive Branch leadership. This annual event will be supplemented by other symposia and workshops at which specific topics are explored in depth. Member participation will be facilitated by using teleconferencing technologies and holding these topical sessions in various regions of the country. The active and diverse publications available to members will further enhance their ability to engage in public policy development on both a local and national level.

WHAT ARE SOME OF THE ISSUES AND TOPICS THAT WOULD BE ADDRESSED BY THE TECHNOLOGY COUNCIL?

Importance of avoiding a narrow, self-serving agenda

Rather than act as an advocate of R&D as a special interest group, the Council would emphasize the ends of technological progress, by setting a visionary agenda for the application of Science and Technology to the benefit of mankind and the citizens of the United States. Issues which are narrow and specific to a particular industry would normally be treated by that industry's association. The Council may, upon request, become involved in such issues and act in support of an association, but its principal role would be in areas where existing associations do not become involved. In this context, there are numerous national issues and problems concerning the health and vitality of the U. S. technological enterprise that need to be addressed by the Council. To be effective, it will be necessary to concentrate on a few of the most critical issues while developing the staff capabilities of the Council. Later, the agenda can be expanded to include other important issues.

Need to re-evaluate negative policies that discourage development of technology

There is broad consensus that American scientific, inventive and engineering resources have not been effectively deployed for the solution of pressing economic and social problems. Further, over the past decade, public policies have created disincentives for innovation, resulting in a marked decline in the rate of technological development and change that now underlays many of our larger economic problems. It must be clearly recognized that the decline in technological innovation is a major component of the present economic malaise and has an effect on the problems of inflation, productivity, balance-of-trade, capital investment, energy and materials resources.

Dynamic nature of Council Agenda

The specific agenda for the Council will be dynamic, reflecting continuing assessment of the government-industry-university relationships that affect the development and effective utilization of technology. The process whereby this agenda is developed will be based upon Council deliberations, utilizing various resources, including consulting its membership, the Policy Advisory Committee and the Council Governing Board as well as the Council Professional staff. External information resources will play a vital role in guiding these bodies, and extensive use will be made of opportunities to explore issues with Congressional and Executive Branch sources. During the formative period for the Council, its capacity for assessment and review of potential issues will be growing and the ability to deal with an increasing set of activities will enable a broader agenda than is initially possible.

During its early development, the Council will have to apply a highly selective process of priority-setting, in order to focus its efforts and increase its impact.

Defense of U.S. technology

In general, the Council will be working in defense of the U.S. technological enterprise and its choice of issues, and the positions it takes will be consistent with this role. Positions that are developed will be publicized and used in interactions with policy-makers and translated into specific courses of action whenever possible. Council policies regarding the clearance and approval process for such statements and advocacy programs will be based upon the principles of timeliness and the broadest possible consensus within the Council.

Typical Issues

Recognizing the dynamic nature of the policy scene and the process and objectives outlined above, the following examples should provide an indication of the types of issues that could be addressed by the Council:

Tax and financial incentives

1. Enactment of an effective national program of tax and financial incentives to stimulate growth in technology directly targeted at:

    a) restoring and maintaining America's competitive advantate in world markets;

    b) solving critical economic, social, and environmental problems;

    c) improving the cost-effectiveness and viability of the national defense; and

    d) advancing America's leadership on the frontiers of science and innovation.

Regulatory and policy reforms

2. Enactment of regulatory and policy reforms that will begin to unravel counter-productive barriers and obstructions to technology innovations including:

    a) reduction of restraints to international and interstate commerce and competition as market barriers to adoption and diffusion of new technology;

    b) patent reforms that encourage full use and exploitation of the nation's technical base;

    c) creation of new market and trade opportunities through government fiscal and procurement policies;

    d) clarification and antitrust regulations to permit industrial cooperation in R&D and encourage the use of the nation's scientific and technological resources; and

e) reform of product liability laws that allow excessive punitative court awards, forcing industrial R&D spending to be used to defend old product lines and discouraging introduction of new technology.

Innovation incentives would be calibrated to achieve the desired impact at least cost to the economy. A full range of tax and financial incentives would be analyzed for cost-effectiveness for achieving each of the objectives. The program could be designed to provide increasing levels of incentives for achieving a hierarchy of national objectives. For instance, the innovation incentives' program could be structured to increase the level of support to channel investments into priority areas to achieve:

a) competitive advantage in world markets
b) supremacy in frontier S&T areas
c) increased venture capital formation
d) solving critical national problems

Revitalizing the economy

Appropriate tax and financial incentives, coupled with a reduction in inappropriate and unnecessary regulatory constraints, could provide a powerful engine for revitalizing the economy and solving a wide range of national problems by exploiting private inventiveness and enterprise. This approach relies on individual initiative, self-reliance and the inventive spirit of American industry to solve problems of national scope, but in the marketplace and at a grass-roots level where they can be best solved. Government intervention at the marketplace level has often failed to deliver the desired impact, largely because such approaches tend to be too inflexible, unimaginative, and/or policy hamstrung.

Continued research in specific technology policy problems

Once tax, financial and deregulation programs have been enacted, market forces will provide an incentive to perform more R&D and to advance the technology base in a wide variety of areas. The Council's efforts can be supportive of this trend and can expand into new areas, for which exploratory evaluation and assessment had been carried out by the staff. These efforts could be aimed at solving more specific technology policy problems, providing coordination and information between government and industry, and evaluating progress and effectiveness of the new innovation incentives. Here too, priorities must be set toward those areas promising greatest benefits. Examples of secondary objectives that may be adopted are:

Positions in specific technical areas

1. Policy research and reviews of critical areas of national technology policy aimed at developing and supporting a comprehensive policy position. These efforts would reinforce and implement the primary objectives of supporting innovations targeted toward economic and other national objectives. Here again, priorities would be set, perhaps focusing on productivity increases that can free capital for investment in other areas of the economy. Areas that may be given attention include:

   - telecommunications
   - automation and robotics
   - energy and materials resources and substitution
   - environmental control
   - argiculture resources
   - biotechnology
   - building materials and architectural systems
   - health and financial security
   - public safety systems
   - information and communications systems
   - space industrialization

Better Government Industry dialogue

2. Institutional problems in public decision-making, R&D management, and the interface between government and industrial sector are difficult to solve, but of vital importance to the efficient and wise use of technical resources over the long-range. Policy research and action on several institutional dimensions of technology policy are also needed although progress will inevitably be slower in these areas.

Public Understanding of Technology

3. Public understanding of technology policy issues is also a major problem that should be addressed, beginning with winning public support for tax-financial incentives. The public must be better informed about scientific and technical basis of major policy decisions to make informed judgments on various technical subjects. Problems that could be addressed are (a) credible sources of information to the press; (b) access to credible technical information by public interest groups; (c) accuracy and credibility of scientific and technical information in policy debates; and (d) unethical use or abuse of scientific and technical knowledge, methods and expertise in the policy-making process.

HOW WOULD THE TECHNOLOGY COUNCIL BE ORGANIZED TO ACHIEVE ITS OBJECTIVES?

Council's dual emphasis - policy development and communication

The organization of the Council should reflect both the important roles of policy development and refinement (the substance of what will need to be communicated) as well as the process of internal and external communication that are critical to the effective advocacy role that the Council is expected to play. Generally, the by-laws, organization, and management of the Council would create a suitable environment to attain high standards of technology policy research, and to maintain an active communication system for information and findings, in order to be both credible and influential in public policy debates.

Given these objectives, the organization that is being suggested would have two major programmatic divisions, **Policy Research and Public Affairs and Information**, and a support division responsible for finance and administration. This leads to an organizational structure for the Council illustrated in Figure 1.

The Council's Assembly

The principal body for developing member input is the Assembly, and all members would be entitled to participate in the Assembly on an equitable basis. The Assembly will meet at least annually, at which time the officers of the Council will report on Council activities, plans for the coming year, and present an accounting of financial and budgetary matters. It is expected that the Annual Assembly will also provide a forum for presentation and review of technology policy issues, workshops for position paper development, and opportunities for interaction with the Government. The Annual Assembly will also elect the following members of the Governing Board:

Chairman (one year term)
Chairman-elect
Six members-at-large (one year terms)

In addition, the Governing Board would include:

12 Senior Members (two year terms - alternating with six elected each year)
Ex-officio: President, Vice-President (Policy Development), Vice-President (Public Affairs and Information Systems), and Chairman of the Policy Advisory Committee.

The candidates for election to the Board will be derived from nominations made by a Nominations and Appointments

Committee that will be responsible for presenting the annual Governing Board Slate.

Council's Governing Board

The Governing Board will serve as the Board of Directors for the Council establishing and reviewing policies and programs, approving key staff appointments and salary structure, establishing and reviewing management principles, and providing a continuing oversight of Council management and activities. Board Members will be paid a nominal fee for their service on the Board.

Policy Advisory COmmittee

The Board will be assisted in its role, particularly regarding the technical content of issue papers and specific positions proposed for the Council by the Policy Advisory Committee. Members of this Committee will be appointed from a list submitted by the President and approved by the Governing Board. Policy Advisory Committee membership will normally be for a period of three years, and will serve on a voluntary basis (expenses paid). Extensive use will be made of electronic circulation and review of materials in its work.

Senior Members of the Governing Board will be nominated and elected by Sponsoring Members of the Council and are intended to provide a degree of continuity on the Board, with six Senior Members retaining their positions at each annual Board election. Senior Members may be re-elected for a maximum of three consecutive terms on the Board.

The Officers of the Council are:

> President - Full time position appointed by the Governing Board for a six-year term. Serves as Chief Exectuve Officer and primary spokesman for the Council. Has full Executive authority to carry out the provisions of the by-laws, implement policy set by the Board, and appoints officers and staff. Reviews and approves all publications submitted by the staff with the advice of the Policy Advisory Committee.
>
> Vice-President (Policy Development) - A full time position nominated by the President and approved by the Board, will be responsible for selecting and managing the staff that will be principally engaged in developing and articulating policy positions for the Council, preparing issue papers, discussions of issues, etc.
>
> Vice-President (Public Affairs and Information) - A full time position nominated by the President and approved by the Board, will manage the internal and external communications of the Council, organize

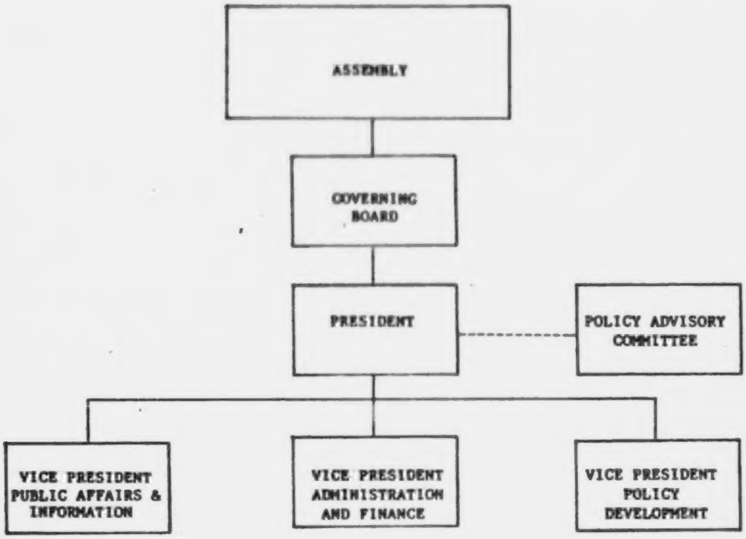
and develop the program for the Annual Assembly, coordinate inputs to the Congress and Executive Branch and other public relations activities.

Vice-President (Membership/Finance) - A full time position appointed by the President, will be responsible for membership development, financial management and budget preparation, and general administration including personnel matters and facility management.

In addition to the principal officers listed above, the staff of the Council may be further structured to facilitate management of its various activities. It is expected that the majority of the staff would be full time and that staff officers would be in the Washington, D.C. area.

A resident research fellowship program would augment the Council's professional staff, bringing mid-level and senior executives and academicians with expertise in desired areas into the Council, to work on critical issues and projects for defined periods (one or two years).

TECHNOLOGY COUNCIL OF THE UNITED STATES


ASSEMBLY
GOVERNING BOARD
PRESIDENT
POLICY ADVISORY COMMITTEE
VICE PRESIDENT PUBLIC AFFAIRS & INFORMATION
VICE PRESIDENT ADMINISTRATION AND FINANCE
VICE PRESIDENT POLICY DEVELOPMENT

INFORMATION

- Publications
- Library
- Teleconference
- Data Bank Network
- Telecommunications
- Journal: *American Technology*

PUBLIC AFFAIRS

- Resource Bank
- Current Affairs Monitoring
- Media Services
- Public Info.
- Gov't. Liaison

ADMINISTRATION

- Personnel
- Facility Management

TREASURER

- Fund Raising
- Membership
- Finance

POLICY DEVELOPMENT

- Near-term problems
- Position Papers
- Current Events
- Advocacy
- Reports

POLICY RESEARCH

- Policy Analysis
- Long-range Problems
- Special Projects
- Journal Articles
- Survey Research
- Policy Sciences
- Statistical Data Bases & Analysis
- Legal Research and Assistance

HOW AND WHEN WILL THE COUNCIL BE FORMED?

Need for Technological Community Support

The process of defining the general nature, objectives and some of the operating characteristics of the Council has begun. This draft description provides the framework on which the Council can be organized, but it will need further refinement and shaping as well as the support and assistance of leaders in the U.S. technological community.

Next Steps

The next steps toward the formal establishment of the Council include:

Step 1a. **Review Draft Description** with a select group of industry, academic, and government leaders, and identify a list of those who would be appropriate for membership on a formal organizing committee. Obtain commitments from approximately thirty individuals who would be willing to become a part of this committee.

Step 1b. In parallel with Step 1a. above, approach possible sources of start-up funding in the range of $10-30K to cover necessary expenses of the organizing process such as supplies, printing, postage, secretarial and administrative support, legal services and travel.

Step 2. **Convene Organizing Committee.** Define leadership for the various organizing functions such as membership, finance, charter and by-laws, program and organization. Initiate the processes of chartering the Council, developing a prospectus and solicitation of further start-up funding. Solicit prospective charter members.

Step 3. **Charter Council**, establish interim Governing Board (based upon Organizing Committee).

Step 4. **Begin Operations.**

Emphasis upon Quality

The above abbreviated sequence is only an outline of the many interrelated steps that must be taken to bring this concept to life. Further refinement of this process will be required and a more detailed description will be a high priority project during the organizational phase. The Council should begin its operations on a firm basis, with high quality workmanship an expected characteristic - from the very beginning of its existence.

Timing

The timing of these steps is not firm, but it is expected that Step 1a and b should be complete by October 1, 1981. Step 2 would occur in October and Step 4 would be approximately January 1, 1982.

The initial work on the Council has been carried out by an exploratory group that has served on a voluntary basis to prepare and review this description. For further information, contact:

Dr. Russell C. Drew
Chairman, Technology Council Exploratory Group
701 Clear Spring Road
Great Falls, Virginia 22066
Tel: (703) 430-1515

Mr. DREW. Finally, I think the institution has to be non-threatening and really non-overlapping with major other institutions that indeed have valuable and continuing roles. I'm concerned about the relationship with the Department of Commerce here. I don't think that has been clearly delineated and those lines carefully enough drawn. The need for a fresh new start here I think seems to be indicated by the past record of what has happened to programs that have found their home in the Department of Commerce in this area.

Finally, I think we have to recognize that it must have something in there for both large and small businesses. I'm a small business or associated with a small business now. I can see the problems there but I can also see the great advantage and the dynamic nature of the small business community. We have to have big firms. We have to have the resources of those big firms in many of the marketplace areas where the U.S. is going to have to be preeminent, but we also need the creativity of the dynamic nature of small businesses and I like the idea of having a separate recognized focus.

SBIR, I think, was one of the best policy implementations that has come down the pike in a long time. I think it needs further expansion actually, but that's an example of a program which could find a special home and a special focus.

Finally, let me go on to the Department of Science and Technology. I've been an advocate of that in the past. I testified before this Committee in favor of it, I think. In the context of today's problem, however, I am asking myself some questions, what does it really do for that and frankly I'm getting maybe not very much. Just bringing those elements together under some large department head seems to be less critical now than I thought maybe one day it was. NSF has shown a lot of power and they have accomplished what I think is a very significant purpose. They have people recognizing the importance of basic research throughout the Congress and the private and public sector.

Basic research is not the answer to the competitiveness problem. Therefore, I was a little dismayed from the President's statement on targeting competitiveness and one of the few financial steps that was included was the doubling of the NSF basic research budget. I think the equivalent is facing a burning building, start building a dam to collect water. They are two different sort of activities. Frankly, I think the foundation probably can stand on its own two feet now as a basic research supporting institution.

That summarizes some favorite points of mine, Mr. Chairman. I will look forward to the opportunity on the part of the IEEE and the American Association of Engineering Societies that are also interested in your continuing review of technology policy and we hope we will be able to provide constructive thoughts, suggestions, comments from time to time.

[The bill H.R. 2164, plus the prepared statement of Dr. Russell C. Drew follow:]

I

100TH CONGRESS
1ST SESSION

H. R. 2164

To advance the national prosperity and welfare, to establish a Department of Science and Technology, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

APRIL 23, 1987

Mr. BROWN of California introduced the following bill; which was referred to the Committee on Government and Operations

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A BILL

To advance the national prosperity and welfare, to establish a Department of Science and Technology, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Department of Science and Technology Act".

SEC. 2. FINDINGS.

The Congress finds and declares that:

(1) The productivity and rate of innovation of many national industries are lagging compared with historical patterns and with the performance of the

same industries in other nations, and are not sufficient to provide for a healthy national economy.

(2) The international balance of trade has been unfavorable to the United States for several years, including unfavorable balances in some industries heavily dependent upon technology.

(3) High-technology industries have been responsible for the creation of a higher share of new jobs than low-technology industries, and the development of new technologies is necessary to restore the United States to a leadership position in many established industries.

(4) The development of a new technology either offers new goods or services for the national welfare or provides existing goods and services at lower costs. Thus, new technologies are generally counterinflationary, facilitate market penetration, improve the national balance of trade, and support the United States dollar in international monetary exchange.

(5) Other development nations generally have closer Government-industry cooperation than does the United States, particularly in the foreign trade area. With the increasingly global trade patterns that accompany world development and the penetration of United States markets by foreign competitors, the United

States will have to provide for closer Government-industry cooperation in order to compete successfully.

(6) To ensure a healthy national society and economy there is a need to forge closer links among sectors of society. In the arena of technology, improved links among Government, industry, academia, and the professions are essential. Many new discoveries and advances in science occur in universities and Government laboratories, while the application of this new knowledge to commercial and useful public purposes depends largely upon actions by business, labor, and other parts of Government.

(7) The efforts of the Federal Government to transfer technology to non-Federal entities could be improved. Such increased efforts would improve dissemination and use of existing Federal technologies within the private sector.

(8) The Nation had not given adequate attention to its requirements for engineering and technical manpower, to the need for engineering and technical research, or to the accomplishment of its engineers and technicians.

(9) The potential of small business for technological innovation and the creation of new jobs is great but

has been inadequately realized, largely through the inattention of Government.

(10) Emerging national problems frequently receive inadequate attention in the executive branch of the Federal Government because existing agencies have existing missions and little incentive to extend themselves beyond those missions. A department with a broad mandate to help United States industry to regain preeminence and to restore a favorable trade balance is badly needed.

(11) Within the National Science Foundation and the Department of Commerce there are several good programs designed to encourage technology development or to meet needs for applied research and development pertinent to national problems. These programs, however, are generally too small to have significant impact and tend to be regarded as stepchildren by the department or agency in which they are currently housed. These programs could form the core of necessary new components of a Department of Science and Technology if organized into an Office of Policy, Analysis, and Assessment, a National Bureau of Technology Transfer, and an Advanced Research Projects Administration.

SEC. 3. PURPOSE.

It is the purpose of this Act to promote the advance of science and technology, technological innovation, technology utilization, and the supply of technological manpower for the improvement of the economic, environmental, and social well-being of the United States by molding the National Science Foundation and selected parts of the Department of Commerce into a Department of Science and Technology.

SEC. 4. DEFINITIONS.

As used in this Act (except where the context otherwise requires)—

(1) the term "Department" means the Department of Science and Technology established by this Act;

(2) the term "Secretary" means the Secretary of Science and Technology;

(3) the term "Board" means the National Technology board established by this Act;

(4) the term "Foundation" means the Advanced Research Projects Foundation established by this Act; and

(5) the term "Director" means the Director of the Advanced Research Projects Foundation.

SEC. 5. ESTABLISHMENT OF THE DEPARTMENT OF SCIENCE AND TECHNOLOGY.

(a) IN GENERAL.—There is hereby established at the seat of government an executive department to be known as the Department of Science and Technology. There shall be at the head of the Department a Secretary of Science and Technology. The Department shall be administered, in accordance with the provisions of this Act, under the supervision and direction of the Secretary.

(b) ENTITIES WITHIN THE DEPARTMENT.—There are hereby established in the Department—

(1) an Office of Policy, Analysis, and Assessment, to function in accordance with section 8;

(2) a National Technology Board, to function in accordance with section 9;

(3) an Advanced Research Projects Foundation, to function in accordance with section 10; and

(4) a National Bureau of Technology Transfer, to function in accordance with section 11.

(c) TRANSFERS TO THE DEPARTMENT.—There are hereby transferred to the Department—

(1) the National Bureau of Standards of the Department of Commerce, which shall become the National Bureau of Standards of the Department;

(2) the National Technical Information Service of the Department of Commerce,. which shall become a

part of the National Bureau of Technology Transfer of the Department;

(3) the National Science Foundation, which shall become the National Science Foundation of the Department;

(4) the National Science Board, which shall become the National Science Board of the Department;

(5) the functions of the Office of Science and Technology Policy contained in title I of Public Law 94-282, which shall be assigned to the Office of Policy, Analysis, and Assessment of the Department;

(6) all the functions, powers, duties, and authorities specifically assigned to the Secretary of Commerce or to the Office of Productivity, Technology, and Innovation under the Stevenson-Wydler Technology Innovation Act of 1980, which shall be assigned to the Office of Policy, Analysis, and Assessment of the Department, except for the Cooperative Research Centers, which shall be transferred to the Foundation and the functions under Public Law 99-382 which shall be transferred to the National Bureau of Technology Transfer; and

(7) such other programs and activities within the executive branch as the President may identify and

transfer by Executive order within six months after the date of the enactment of this Act.

SEC. 6. SECRETARY OF SCIENCE AND TECHNOLOGY.

(a) IN GENERAL.—The Secretary shall be appointed by the President, by and with the advice and consent of the Senate. Before any person is appointed as Secretary, the President shall afford both the Board and National Science Board the opportunity to make recommendation with respect to such appointment. The Secretary shall receive basic pay at the rate payable for level I of the Executive Schedule under section 5312 of title 5, United States Code.

(b) AUTHORITY TO DELEGATE FUNCTIONS.—The Secretary may make such provisions as he deems appropriate authorizing the performance by any other officer, agency, or employee of the Department of any of his functions under this Act.

(c) FORMULATION OF PROGRAMS AND BUDGETS.—The Secretary shall formulate the programs and budgets of the Department.

SEC. 7. DEPUTY SECRETARY AND OTHER OFFICERS.

(a) DEPUTY SECRETARY.—There shall be a Deputy Secretary of Science and Technology who shall be appointed by the President, by and with the advice and consent of the Senate. Before any person is appointed as Deputy Secretary, the President shall afford the Board and the National Science

Board the opportunity to make recommendations with respect to such appointment. The Deputy Secretary shall receive basic pay at the rate payable for level II of the Executive Schedule under section 5313 of title 5, United States Code, shall serve as the Director of the Office of Policy, Analysis, and Assessment within the Office of the Secretary, and shall perform such other duties and exercise such powers as the Secretary may prescribe. The Deputy Secretary shall act for, and exercise the powers of, the Secretary during the absence or disability of the Secretary or in the event of a vacancy in the office of Secretary.

(b) UNDERSECRETARIES.—There shall be two Undersecretaries of Science and Technology, one of whom shall serve as the Director of the National Science Foundation and the other of which shall serve as the Director. They shall each receive basic pay at the rate payable for level III of the Executive Schedule under section 5314 of title 5, United States Code, and shall be appointed by the President, by and with the advice and consent of the Senate.

(c) ASSISTANT SECRETARIES.—There shall be as many as nine Assistant Secretaries of Science and Technology who shall be appointed by the President, by and with the advice and consent of the Senate. Each Assistant Secretary shall receive basic pay at the rate payable for level IV of the Executive Schedule under section 5315 of title 5, United States

Code, and shall perform such duties and exercise such powers as the Director may prescribe. One Assistant Secretary shall have responsibility for each of the following:

(1) the Office of General Counsel;

(2) the Office of Inspector General;

(3) the National Bureau of Standards; and

(4) the National Bureau of Technology Transfer.

(d) IDENTIFICATION OF FUNCTIONS.—At the time of the name of any individual is submitted for confirmation to the position of Assistant Secretary, the President shall identify with particularity the function or functions for which such individual will be responsible.

(e) ADDITIONAL OFFICERS.—There shall be up to 10 additional officers of the Department who shall receive basic pay at the rate payable for level V of the Executive Schedule under section 5316 of title 5, United States Code.

SEC. 8. OFFICE OF POLICY, ANALYSIS, AND ASSESSMENT.

The Office of Policy, Analysis, and Assessment shall be composed of divisions on International Science and Technology Policy, on Institutional and Human Resource Development, on National Programs, and on National Science and Technology Policy Coordination. In addition to performing the functions transferred to it under section 5 the Office shall—

(1) foster communication between scientific and technological agencies of the Federal Government and the business community;

(2) recommend to the Director for transmission to the President such changes in the laws, procedures, and practices of the Federal Government as may be required to enable the Nation's businesses to benefit more fully from more advanced and newer technologies;

(3) encourage the temporary exchange of professional personnel between academia and industry to promote the purpose of this Act as set forth in section 3;

(4) conduct technology assessments, including studies of the effects of technology upon the quality of national life;

(5) determine the relationships of technological developments and international technology transfers to the output, employment, productivity, and world trade performance of United States and foreign industrial sectors;

(6) in cooperation with statistical agencies of the Federal Government, develop improved indicators of the state of technology, such as measures of innovation and productivity;

(7) determine the influence of economic conditions, labor conditions, industrial structure and management, and government policies on industrial innovation and development of technology;

(8) determine the influence and effects of technology utilization upon the environment, health, and social well-being of our society;

(9) identify technological needs, problems, and opportunities within and across industrial sectors that, if addressed, could make a significant contribution to the economy, health, environment, and social well-being of the United States;

(10) assess whether the capital, technical, and other resources being allocated to domestic industrial sectors which are likely to generate new technologies are adequate to meet private and social demands for goods and services and to promote productivity and economic growth;

(11) propose and support studies and policy experiments, in cooperation with other Federal agencies, to determine the effectiveness of measures with the potential of advancing United States technological innovation;

(12) recommend to the Director, for transmission to the President and Congress, Government measures

with the potential of advancing United States technological innovation and exploiting innovations of foreign origin to further the purpose of this Act;

(13) survey international technological developments; and

(14) develop a national technology policy and plan for periodic updating of such policy.

SEC. 9. NATIONAL TECHNOLOGY BOARD.

(a) IN GENERAL.—There is established within the Department a National Technology Board. The Board shall consist of 24 members to be appointed by the President, by and with the advice and consent of the Senate. In addition to any powers and functions otherwise granted to it by this Act, the Board shall establish general policy for the Advanced Research Projects Foundation and review its budget and programs, within the framework of applicable national policies as set forth by the President and the Congress.

(b) APPOINTMENT OF MEMBERS.—The persons nominated for appointment as members of the Board (1) shall be eminent in the fields of business, labor, research, new product development, engineering, law, education, management consulting, environment, international relations, and public affairs; (2) shall be selected solely on the basis of established records of distinguished service; and (3) shall be so selected as to provide representation of a cross-section of the current and emerging industrial voice of the Nation. The President is requested, in the making of nominations of persons for appointment as members of the Board, to give due consideration to any recommendations for nomination which may be submitted to him by the National Academies, professional societies, business associations, labor associations, and other appropriate organizations.

(c) TERMS OF OFFICE.—(1) The term of office of each member of the Board, other than the original members, shall be 6 years; except that any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed for the remainder of such term. Any person, other than the Director, who has been a member of the Board for 12 consecutive years shall thereafter be ineligible for appointment during the two-year period following the expiration of such 12th year.

(2) The original members of the Board shall be elected to 3 classes of 8 members each; one class shall have a term of 2 years, one a term of 4 years, and the other a term of 6 years.

(d) MEETINGS.—The Board shall meet at least quarterly at the call of the Chairman or whenever one-third of the members so request in writing. A majority of the members of the Board shall constitute a quorum. Each member shall be given notice, by registered mail or certified mail mailed to his last known address of record not less than 15 days prior to any meeting, of the call of such meeting.

(e) EXECUTIVE COMMITTEE; OTHER COMMITTEES.—The Board shall have an executive committee, and may delegate to it or to the Secretary such of the powers and functions granted to the Board by this Act as it deems appropriate. The Board is authorized to appoint from among its members such other committees as it deems necessary, and to assign to committees so appointed such survey and advisory functions as the Board deems appropriate to assist it in exercising its powers and functions under this Act.

(f) CHAIRMAN AND VICE CHAIRMAN.—The election of the Chairman and Vice Chairman of the Board shall take place at each annual meeting occurring in an even-numbered year. The Vice Chairman shall perform the duties of the Chairman in his absence. In case a vacancy occurs in the chairmanship or vice chairmanship, the Board shall elect a member to fill such vacancy.

(g) STAFF.—The Board may, with the concurrence of a majority of its members, permit the appointment of a staff consisting of not more than 5 professional staff members and such clerical staff members as may be necessary. Such staff shall be appointed by the Secretary, after consultation with the Chairman of the Board, and assigned at the direction of the Board. The professional members of such staff may be appointed without regard to the provisions of title 5 governing appointments in the competitive service, and the provisions of chapter 51 of title 5 relating to classification, and compensated at a rate not exceeding the appropriate rate provided for individuals in grade GS-18 of the General Schedule under section 5332 of title 5, as may be necessary to provide for the performance of such duties as may be prescribed by the Board in connection with the exercise of its powers and functions under this Act.

(h) SPECIAL COMMISSIONS.—The Board is authorized to establish such special commissions as it may from time to time deem necessary for the purposes of this Act.

(i) REPORTS.—(1) The Board shall render an annual report to the President, for submission to the Congress on or before January 31 in each year. Such report shall deal essentially, though not necessarily exclusively, with policy issues or matters which affect the Foundation or with which the Board in its official role as the policymaking body of the Foundation is concerned.

(2) The Board shall render to the President and the Congress such additional reports on specific policy matters as it deems appropriate.

SEC. 10. ADVANCED RESEARCH PROJECTS FOUNDATION.

(a) IN GENERAL.—There is established in the Department an agency to be known as the Advanced Research

Projects Foundation. The Foundation shall consist of a National Technology Board and a Director.

(b) FUNCTIONS.—The Foundation is authorized and directed—

(1) to conduct programs of research and other activities to lay the groundwork for the development and use by United States industry of advanced and innovative manufacturing and process technologies;

(2) to conduct programs of research and other activities jointly with consortia of United States industry aimed at solving generic problems of specific industries and making those industries more competitive in world markets;

(3) to award grants and enter into contracts for the purpose of ensuring that United States industry including small business is competitive in emerging high-technology industries;

(4) to enter into cost-sharing arrangements with United States industry to install, test, and shake down major first-of-kind equipment or existing equipment in new applications if such arrangements, in opinion of the Director and the Board, will help increase competitiveness of participating industries in world markets;

(5) to carry out all functions, powers, duties, and responsibilities related to the Cooperative Research

Centers created under section 4 and section 6 of the Stevenson-Wydler Technology Innovation Act of 1980; and

(6) to assist industry as requested, in providing for the skilled workforce necessary to run high-technology equipment including, but not limited to, curriculum development and the establishment of model training programs at educational institutions, industrial classrooms, and elsewhere.

SEC. 11. NATIONAL BUREAU OF TECHNOLOGY TRANSFER.

The National Bureau of Technology Transfer, in addition to performing those functions transferred to it under section 5, shall—

(1) in coordination with existing public and private systems and in cooperation with the Office of Policy, Analysis, and Assessment, develop and implement a coherent National Information and Statistics Policy directed to fuller and more efficient utilization of existing information systems and the meeting of presently unfulfilled national information needs, including the information required for informed public and private policy formulation;

(2) in cooperation with other public and private agencies and the National Office of Policy, Analysis, and Assessment, develop comprehensive computerized

National Information and Statistics Data Banks and indexes to be made readily accessible to Federal, State, and local governments, business and industrial concerns, educational institutions, and other interested individuals and organizations;

(3) collect, analyze, compile, and publish information concerning grants and contracts awarded to business concerns by scientific and technological agencies of the Federal Government, and the procedures for handling proposals submitted by small business concerns;

(4) assist individual business concerns in obtaining information regarding programs, policies, regulations, and procedures of the Federal Government, and assist such businesses in dealing with the Federal Government;

(5) review the Government's existing information collection and dissemination functions and facilities and recommend improvements and methods of filling information gaps avoiding duplication, creating an index of information sources, and implementing maximum utilization;

(6) provide a full array of information and statistical services regarding inventions, technical information, products, processes, research, and development from

the Federal laboratories and agencies as well as foreign advancements;

(7) act as a repository of all nonproprietary scientific and technical information collected by Federal agencies, including information on technical innovation process and foreign manufacturing technologies; and

(8) operate a clearinghouse for data relating to technological innovation and industrial competence to coordinate available information resources in the private sector.

SEC. 12. GENERAL AUTHORITY OF THE DEPARTMENT.

(a) IN GENERAL.—The Secretary shall have the authority, within the limits of available appropriations, to do all things necessary to carry out the provisions of this Act, including (but not limited to) the authority—

(1) to establish additional offices and other organizational structures within the Department;

(2) to prescribe such rules and regulations as the Secretary deems necessary governing the manner of the Department's operations and its organization and personnel;

(3) to make such expenditures as may be necessary for administering the provisions of this Act;

(4) to enter into grants, contracts, cooperative agreements, or other arrangements with whatever per-

sons, organizations, or other entities are deemed most useful by the Secretary to accomplish the purpose of this Act;

(5) to acquire, hold, and sell real and personal property of all kinds necessary to carry out the purpose of this Act;

(6) to receive and use funds and property donated by others, if such funds and property may be used in furtherance of the purpose of this Act, and to request the Secretary of the Treasury to invest and reinvest such funds in securities of the United States or in securities guaranteed by the United States, with principal and interest deposited to the credit of the Department and disbursable upon the order of the Secretary;

(7) to accept and utilize the services of voluntary and uncompensated personnel and to provide transportation and subsistence as authorized by section 5703 of title 5, United States Code, for persons serving without compensation;

(8) to arrange with and reimburse other Federal agencies for any activity which the Department is authorized to conduct;

(9) to receive funds from other Federal agencies for any activity which the Department or such other agencies are authorized to conduct, either in advance

of or after performance of such activities by the Department or its contractors;

(10) to appoint and fix the compensation of personnel, including temporary personnel and consultants, necessary to carry out the provisions of this Act; and

(11) to appoint, without regard to the civil-service laws, such advisory committees as shall be appropriate for the purpose of consultation with and advice to the Department in performance of its functions.

(b) Except as provided otherwise in this Act, appointments of individuals under subsection (a)(10) shall be made and their compensation fixed in accordance with the provisions of chapter 51 and subchapter III of chapter 53 of title 5, United States Code, except that the Secretary may, in accordance with such policies as the Board or the National Science Board shall prescribe, employ technical and professional personnel and fix their compensation, without regard to such provisions, as he deems necessary to carry out the purpose of this Act.

SEC. 13. COORDINATION OF PROGRAMS.

(a) IN GENERAL.—The Secretary shall ensure that all programs of the Department are coordinated with other programs of the Federal Government, with the private sector, and with State and local government programs.

(b) ASSISTANCE TO OSTP.—The Secretary is authorized and directed to provide assistance to the Office of Science and Technology Policy upon its request.

SEC. 14. MISCELLANEOUS PROVISIONS.

(a) EXERCISE OF AUTHORITY AVAILABLE TO SECRETARY OF COMMERCE.—The Secretary may exercise any authority available by law to the Secretary of Commerce with respect to any entity transferred to the Department by section 5(c), and the actions of the Secretary in exercising such authority shall have the same force and effect as when exercised by the Secretary of Commerce.

(b) REALLOCATIONS AND FURTHER TRANSFERS OF FUNCTIONS.—The Secretary may allocate or reallocate functions among the organizational components of the Department and make recommendations for transfers of functions to other parts of the executive branch.

(c) REGIONAL AND FIELD OFFICES.—The Secretary may establish, alter, discontinue, or maintain such regional and other field offices as the Secretary may find necessary or appropriate to perform the functions of the Department.

(d) TRANSFER OF FUNDS WITHIN DEPARTMENT.—The Secretary, when authorized in an appropriation Act in any fiscal year, may transfer funds from one appropriation to another within the Department except that no appropriation for any fiscal year shall be either increased or decreased pursuant to this subsection by more than 5 percent and no such transfer shall result in increasing any such appropriation above the amount authorized to be appropriated therefor.

(e) ANNUAL REPORT.—The Secretary shall, as soon as practicable after the end of each calendar year, make a report to the President for submission to the Congress on the activities of the Department during the preceding calendar year.

(f) SEAL.—The Secretary shall cause a seal of office to be made for the Department, of such device as the Secretary shall approve, and judicial notice shall be taken of such seal.

(g) CONGRESSIONAL RELATIONS.—The Secretary shall keep the appropriate authorizing committees of the House of Representatives and the Senate fully and currently informed with respect to all the activities of the Department.

(h) SALARIES OF PRINCIPAL OFFICERS.—Chapter 53 of title 5, United States Code, is amended—

(1) by adding at the end of section 5312 the following new item:

"Secretary of Science and Technology";

(2) by adding at the end of section 5313 the following new item:

"Deputy Secretary of Science and Technology";

(3) by striking out "Director, National Science Foundation" in section 5313;

(4) by adding at the end of section 5314 the following new item:

"Undersecretaries of Science and Technology (2)";

(5) by adding at the end of section 5314 the following new item:

"Assistant Secretaries of Science and Technology (9)"; and

(6) by adding at the end of section 5316 the following new paragraph:

"Miscellaneous Officers, Department of Science and Technology (10)".

SEC. 15. TRANSITIONAL, SAVINGS, AND CONFORMING PROVISIONS.

(a) TRANSFER AND ALLOCATION OF APPROPRIATIONS AND PERSONNEL.—Except as otherwise provided in this Act, the personnel employed in connection with, and the assets, liabilities, contracts, property, records, and unexpended balance of appropriations, authorizations, allocations, and other funds employed, held, used, arising from, available to, or to be made available in connection with the entities, functions, and offices (or portions thereof) transferred by this Act, subject to section 1531 of title 31, United States Code, shall be transferred to the Secretary for appropriate allocation. Unexpended funds transferred pursuant to this subsection shall be used only for the purposes for which the funds were originally authorized and appropriated.

(b) Effect on Personnel.—(1) Except as otherwise provided in this Act, the transfer pursuant to this title of full-time personnel (except special Government employees) and part-time personnel holding permanent positions shall not cause any such employee to be separated or reduced in grade or compensation for one year after the date of transfer to the Department.

(2) Any person who, on the day preceding the effective date of this Act, held a position compensated in accordance with the Executive Schedule prescribed in chapter 53 of title 5, United States Code, and who, without a break in service, is appointed in the Department to a position having duties comparable to the duties performed immediately preceding such appointment shall continue to be compensated in such new position at not less than the rate provided for such previous position, for the duration of the service of such person in such new position.

(c) Incidental transfers.—(1) The Director of the Office of Management and Budget, at such time or times as the Director shall provide, is authorized and directed to make such determinations as may be necessary with regard to the entities, functions, offices, or portions thereof transferred by this Act, and to make such additional incidental dispositions of personnel, assets, liabilities, grants, contracts, property, records, and unexpended balances of appropriations, authorizations, allocations, and other funds held, used, arising from, available to, or to be made available in connection with such functions, offices, or portions thereof, as may be necessary to carry out the provisions of this Act. The Director shall provide for the termination of the affairs of all entities terminated by this Act and for such further measures and dispositions as may be necessary to effectuate the purposes of this Act.

(2) After consultation with the Director of the Office of Personnel Management, the Director of the Office of Management and Budget is authorized, at such time as the Director of the Office of Management and Budget provides, to make such determinations as may be necessary with regard to the transfer of positions within the Senior Executive Service in connection with functions and offices transferred by this Act.

(d) SAVINGS PROVISIONS.—(1) All orders, determinations, rules, regulations, permits, grants, contracts, certificates, licenses, and privileges—

(A) which have been issued, made, granted, or allowed to become effective by the President, any Federal department or agency or official thereof, or by a court of competent jurisdiction, in the performance of functions which are transferred under this Act to the Secretary or the Department, and

(B) which are in effect at the time this Act takes effect,

shall continue in effect according to their terms until modified, terminated, superseded, set aside, or revoked in accordance with the law by the President, the Secretary, or other authorized official, a court of competent jurisdiction, or by operation of law.

(2)(A) The provisions of this Act shall not affect any proceedings, including notices of proposed rulemaking, or any application for any license, permit, certificate, or financial assistance pending on the effective date of this Act before any department, agency, commission, or component thereof, functions of which are transferred by this Act. Such proceedings and applications, to the extent that they relate to functions so transferred, shall be continued.

(B) Orders shall be issued in such proceedings, appeals shall be taken therefrom, and payments shall be made pursuant to such orders, as if this Act had not been enacted. Orders issued in any such proceedings shall continue in effect until modified, terminated, superseded, or revoked by the Secretary, by a court of competent jurisdiction, or by operation of law.

(C) Nothing in this paragraph shall be deemed to prohibit the discontinuance or modification of any such proceeding under the same terms and conditions and to the same extent that such proceeding could have been discontinued or modified if this Act had not been enacted.

(D) The Secretary is authorized to promulgate regulations providing for the orderly transfer of proceedings continued under this subsection to the Department.

(3) Except as provided in paragraph (5)—

(A) the provisions of this Act shall not affect suits commenced prior to the effective date of this Act, and

(B) in all such suits, proceedings shall be had, appeals taken, and judgments rendered in the same manner and effect as if this Act had not been enacted.

(4) No suit, action, or other proceeding commenced by or against any officer in the official capacity of such individual as an officer of any department or agency, functions of which are transferred by this Act, shall abate by reason of the enactment of this Act. No cause of action by or against any department or agency, functions of which are transferred by this Act, or by or against any officer thereof in the official capacity of such officer shall abate by reason of the enactment of this Act.

(5) If, before the date on which this Act takes effect, any department or agency, or officer thereof in the official

capacity of such officer, is a party to a suit, and under this Act any function of such department, agency, or officer is transferred to the Secretary or any other official of the Department, then such suit shall be continued with the Secretary or other appropriate official of the Department substituted or added as a party.

(6) Orders and actions of the Secretary in the exercise of functions transferred under this Act shall be subject to judicial review to the same extent and in the same manner as if such orders and actions had been by the agency or office, or part thereof, exercising such functions immediately preceding their transfer. Any statutory requirements relating to notice, hearings, action upon the record, or administrative review that apply to any function transferred by this Act shall apply to the exercise of such function by the Secretary.

(e) REFERENCE.—With respect to any function transferred by this Act and exercised on or after the effective date of this Act, reference in any other Federal law, rule, regulation, or other official paper to any department, commission, or agency or any officer or office the functions of which are so transferred shall be deemed to refer to the Secretary, other official, or component of the Department to which this Act transfers such functions.

SEC. 16. AUTHORIZATION OF APPROPRIATIONS.

Appropriations are authorized for the functions specifically set forth in this Act. The Secretary, within 90 days after the date of the enactment of this Act, shall submit to the Congress recommendations for such additional authorizations of appropriations for fiscal years 1988 and 1989 as may be necessary to carry out the responsibilities contained in this Act.

SEC. 17. EFFECTIVE DATE AND INTERIM APPOINTMENTS.

(a) EFFECTIVE DATE.—(1) This Act shall take effect 180 days after the first Secretary takes office, or on such earlier date (after the date of the enactment of this Act) as the President may prescribe and publish in the Federal Register; except that at any time after the date of the enactment of this Act—

(A) any of the officers provided for in section 7 may be nominated and appointed, as provided for in such section; and

(B) the Secretary may promulgate regulations to implement this Act and carry out its purpose.

(2) Funds available to any department or agency (or any official or component thereof), the functions or offices of which are transferred to the Secretary or the Department by this Act, may, with the approval of the Director of the Office of Management and Budget, be used to pay the compensation and expenses of any officer appointed pursuant to this Act

and other transitional and planning expenses associated with the establishment of the Department, or with the transfer of functions or offices thereto, until such time as funds for such purposes are otherwise available.

(b) INTERIM PERSONNEL.—(1) With the consent of the appropriate department or agency head concerned, the Secretary is authorized to utilize the services of such officers, employees, and other personnel of the departments and agencies from which functions or offices have been transferred to the Secretary or the Department by this Act, and funds appropriated to such functions or offices, for such period of time as may reasonably be needed to facilitate the orderly implementation of this Act.

(2)(A) In the event that any officer required by this Act to be appointed by and with the advice and consent of the Senate shall not have entered upon office on the effective date of this Act and that the services of another officer or employee cannot be utilized as provided in paragraph (1), and notwithstanding any other provision of law, the President may designate an officer in the executive branch to act in such office for 120 days or until the office is filled as provided in this Act, whichever first occurs.

(B) Any officer acting in an office in the Department pursuant to the provisions of subparagraph (A) shall receive compensation at the rate prescribed for such office under this Act.

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Testimony of Dr. Russell C. Drew
On Behalf of the
Institute of Electrical and Electronics Engineers, Inc.
Addressing
The National Policy and Technology Foundation Bill
and
The Department of Science and Technology Act
Before the
The Science, Research and Technology Subcommittee,
House Science, Space and Technology Committee
April 30, 1987

Mr. Chairman:

I am pleased to have this opportunity to testify on behalf of the US Activities Board of the IEEE on two measures that have been introduced to deal with major issues of concern to our organization--- the competitiveness of US industry and the health of science and technology in this nation. Our concern predates these proposals and has been the subject of testimony presented by the IEEE over the past several years. The continued decline of the US balance of trade for high technology products as well as the sense of frustration that has resulted from the inability to define clear solutions to the problem has heightened the sense of urgency for action both by the public and private sectors.

In this context, the two bills being considered here today, the National Policy and Technology Foundation Act and the Department of Science and Technology Act, are a valuable first step toward the definition of new measures to mobilize our scientific and engineering resources and direct these resources more effectively toward the solution of our current problems. We support them in principle and strongly endorse further discussion and refinement over the coming months.

It is difficult to know where to begin, in commenting on the many complex relationships that are involved in the two bills, and the many aspects of technology policy that are addressed. Rather than proceed through the two bills systematically, a process that we will be happy to carry out later with your staff, let me focus my comments upon the broad principles and objectives of the bills and their major features.

In general, a useful technique for reviewing such legislation is to consider first, whether there is a problem that needs attention; second, whether Government has a role in solving the problem; and finally, whether the proposed solution a) addresses the problem, and b) has some likelihood of working, if enacted. With respect to the first of these, it is clear that a great deal of attention has been given to such evidence of our current difficulties as balance of trade data and, in particular to the practices of our trading partner, Japan, as symptomatic of our overall decline and the type of competition that we face. However, there is a tendency to proceed from this data to blame "an absence of consistent, rational, nationally visible and accepted public policy" as a prime cause of the problem. This appears to place a bit too much priority on public policy as a causal factor, with the very dangerous prospect that the public could be led to expect that simply finding the right new public policy measures will "get us out of this mess." This oversimplifies the problem and carries some risks with it.

Given that it is a great deal easier to point to the obvious evidences of our problems (trade balances, deficits, etc.) than to identify the underlying factors, let me nevertheless make an attempt at the risky task of characterizing some of these factors. It appears to me that the root causes of our current difficulties involve societal attitudes, failures in our educational systems, the proliferation of "professional managers" with no knowledge of technology, the growing fact-of-life of a global economy, and the cumulative burden of providing a security umbrella for the free world, as well as a variety of public policy deficiencies. Some of these are susceptible to legislative action and some are not. Thus, an effort to treat the total problem would involve reform of a number of institutions, a broad program to build public awareness, and extensive private sector contributions, as well as new legislative measures. I'm pleased to report that the engineering community, and the IEEE in particular, have recognized the broader aspects of the problem and are helping to address such issues as pre-college math and science education needs, management practices as they apply to the improved utilization of the engineering workforce, continuing education in the profession, and other related matters that are mostly outside of the domain of Federal legislation.

Restated in a somewhat different way, what I am saying is that the problems we face are large and complex, of very great consequence to the nation, and involve not only the need for legislative remedies, but also the need to mobilize all elements of our society. With this in mind, remedies will be difficult to identify and even more difficult to implement. But we must try to define solutions, debate them in public forums, and based upon this debate, refine the proposed solutions into workable legislation or other action-oriented programs. Let me complement you and the other members of this committee for your continued pioneering efforts in this regard. The two bills highlight very important missing elements of national policy, and constitute a very constructive first step in the process I have just described. We also look forward to the in depth review of technology policy that this committee will be conducting over the next year or so as an opportunity to provide additional inputs from time to time and to participate in the public debate that is needed on this important topic.

Now, let me move to the specific bills that have been introduced. First, the National Policy and Technology Foundation Act.

Briefly, the roles of the Foundation can be summarized as 1) information gathering and dissemination, 2) policy analysis, 3)technology development, 4)human resource development, and 5)technology transfer, including the Patent and Trademark Office. In addition, there are several functioning offices and programs that would be transferred to the new foundation, on the premise that they would find a more hospitable home in the foundation than where they are presently located.

The proposed legislation deals with the problem of improved information flow to the private sector via a proposed National Information Office. Quite a bit of the data that is to be the concern of that office is currently already available from various private and public data sources. It is not generally assembled into a unified and reasonably consistent data base, however and this could be a valuable function for the Foundation. I believe it is important that, in dealing with this problem, great care be taken to avoid replacing private sector suppliers of this information with a Federal government source. Perhaps a workable arrangement would be to require the Foundation to utilize private resources whenever these are available, and include adequate payment for data that was redistributed by the Foundation to customers that might otherwise have obtained the data from the private supplier. With this caveat, it appears that the information and data function would be a valuable asset for both industry and government and that a suitably structured function of this nature would be desirable as part of the Foundation.

A particularly important aspect of the information collection and dissemination function for the Foundation is information about technological advances made overseas and about export markets and foreign sales opportunities. Greater availability of translations of foreign journals could also enhance more rapid awareness of progress being made in key fields by other nations and thus facilitate access to new inventions early in their development cycle.

We also endorse the second role, that of policy assessment, which is based upon the premise that there is an important gap in the policy process regarding the effective utilization of our national technological capacity. The bill properly recognizes that it is not the lack of technology policies that is a problem, but rather the lack of some cross-cutting or consistent basis for all of the fragmented and sometimes contradictory technology policies that have been put in place to solve some specific crisis or another. This function is also valuable as an aid to the definition of policy options and their evaluation. Again, the work by the Foundation staff should not replace the contributions of private sector sources, particularly university groups working in the field. There are relatively few such groups today, a reflection of the lack of adequate external financial support. One of the useful roles of the Foundation would be to stimulate development of centers of excellence at universities or not-for-profit institutes for the study and advancement of technology policy analyses. A very modest investment in this area could have very large payoffs in the future and would yield a much better understanding of the complex interrelationships between technological advances and the various incentives or disincentives that are implicit in our current system.

The third major function, technology development, includes programs from the NSF and the Department of Commerce. While the assumption is that there will be a more hospitable home for the transferred programs than in their current locations, this may not be entirely true. For example, the Directorate of Engineering in NSF, while having to compete with the other discipline-oriented directorates within the NSF for increased funding, has shown signs of emerging from its previous second-class citizen status to become one of the priority areas within the NSF. If the new Foundation is created, it would not be inappropriate to shift the Engineering Directorate to it, because of the synergism with other technology-oriented programs. But the need for a new home for the Directorate is not a reason for the proposed Foundation. In general, if a new Foundation is created, it should have some substantial operating programs, and the ones that have been identified seem appropriate.

In this regard, the special attention devoted to small business seems particularly appropriate. One of the previous great strengths of the US economic system has been its flexibility and the disaggregation of decision-making that facilitates the generation of new products quickly to take advantage of new market opportunities. There appears to have been a significant "hardening of the arteries" in larger firms in recent years and a distinct lack of the willingness to take the risks needed either to move quickly or to make the long-term investments to generate new products. To a large extent, the really new products are being generated by small businesses and find their way into large firms through acquisition or license arrangements. That we have been able to take advantage of these alternate routes to innovation is a tribute to our flexibility and resilience.

In the years ahead we will need both dynamic and vigorous large businesses and creative new small businesses, since both have important roles to play. In particular, large businesses need to be given more incentives to modernize and to initiate new products attractive to the world marketplace, rather than dissipate their resources in either battling or initiating take-over attempts. Small businesses need more access to Federal contracting and to the information resources necessary to permit them to become more aware of competitive opportunities for export of their products. The SBIR program has been, in my view, a great success story of a technology policy initiative that has paid off and will continue to yield dividends over the coming years. There may be changes that can be incorporated that would make it even more effective, and these would be an important topic for the proposed Foundation.

The fourth major function, dealing with human resources, is a particularly significant role for the proposed Foundation. A key factor in the utilization and expansion of our technology base is an adequate supply of trained engineers supported by skilled technicians. The system for production of new engineers has been studied extensively recently and continues to receive attention by academic leaders and by the various professional societies, and I will not comment on the adequacies or inadequacies of the educational system at this time. However, it is important to note that this system operates very much in an open loop, that is, there is no structured relationship between the output of new engineers and the demand for such skilled individuals in the economy. An improved understanding of the dynamics of the profession, particularly in anticipation of prospective increased needs, would be very valuable. Previous efforts to stimulate the supply of engineers, particularly in the early part of the 1960s, turned out to be out of phase with the decreasing demands as the space program cut back in the wake of Apollo and the result was the demoralizing picture of highly trained engineers pumping gas or driving taxi cabs. We need to avoid such mistakes and we also need to be able to anticipate increased demands, as well.

The remaining major function, the promotion of technology transfer, is also well recognized as an important area for government assistance. The Patent system, specified in the Constitution of the United States, probably can lay claim to be technology policy number one. It's purpose was to provide an incentive to promote technology transfer by giving a financial benefit to inventors and a period of guaranteed rights in return for public disclosure of their technology. We need to keep these objectives in mind and ensure that we have a functioning and up-to-date patent system that continues to be an effective incentive to invention. The IEEE has encouraged greater inventor rights for work done for employers. In general, we believe both the employer and the individual inventor will profit from such increased incentives to individual creativity. The proposed Foundation would provide a forum for further reform of industrial patent policies and a return of more effective incentives for US inventors.

Taken together, the various functions that have been proposed for the Foundation present an impressive array of challenges. The details of the various functions clearly need additional work and refinement. There is a degree of "fuzziness" about some of the functions and missions that needs to be clarified. In some areas, the assignments appear to be "mission impossible", yet the large body of the material and the principles that have been enunciated deal with an important national need that demands urgent attention, and we support continued work to develop this bill into a form that can become law.

The second bill, establishing a Department of Science and Technology, raises an issue that has engaged this committee in previous years, and has had the benefit of extensive testimony by numerous witnesses. In the oft-used phrase, "if it isn't broke, don't fix it", there is a useful principle that needs to be kept in mind in this legislation. Given the broad perception of a problem--- industrial competitiveness--- and the growing appreciation of the nature of the changed international competitive environment, any corrective measure should be oriented and structured to strengthen the industrial performers who, in the final analysis, will be responsible for generating the better, more cost-effective products that are needed to turn around the current situation.

The rather limited version of the Department of Science and Technology that is included in the current bill has elements of an increased focus on technology married with the NSF, which is almost exclusively focused on basic research. This suggests the prospect of coordinated science and technology efforts through the office of the Secretary of the Department. However, the nature of the problems and many of the performers are very different in the two areas, which I suspect will lead to an uncomfortable marriage between the two. Having two separate policy boards, a Science Board and a Technology Board, will also create rivalries and conflicts that are not likely to be of benefit to either area. A single board that spans the two areas is much to be preferred.

But the question to be answered is whether there is an advantage to have the various elements in a DST compared with a separate National Policy and Technology Foundation. For all of the reasons that have been cited earlier in my testimony, the Foundation appears to fill an important gap in our national treatment of technology policy and also consolidates important aspects of its implementation. The additional advantages of a Department of Science and Technology beyond the Foundation concept are less apparent. However, we believe the proposal should be given careful consideration in the context of the current crisis that we face in industrial competitiveness. It should be given the test of relevance--does this step make a positive contribution to the solution of our problem?

In summary, Mr. Chairman, we applaud your efforts and the efforts of the committee to focus attention on the very critical role that technology can and should play in helping the US deal with the current problems with our foreign trade balance and with the future health of the US economy. Effective exploitation of high technology to improve our industrial processes and to generate new products will be essential to our national well-being, and given the vital role that we play in defending the free world, will be of consequence to people throughout the world. Without the coherent development of new policies in such diverse areas as taxes, human resources, labor standards, capital formation, stock transactions and corporate takeovers, graduate education, and other areas that have a significant impact upon our ability to generate and effectively use technology, we risk further serious deterioration in our current position. Therefore, we strongly support broad discussion of the measures you are considering and look forward to the opportunity to give further comments and suggestions in the coming months. We believe that there is precious little time to act on these issues, yet there is a need to build consensus and to refine the concepts.

This completes my prepared statement. I will be pleased to respond to any questions you may have.

DR. RUSSELL C. DREW

Dr. Russell C. Drew received his Bachelor's degree in Engineering Physics from the University of Colorado in 1953 and his Ph.D. in Physics from Duke University in 1961. From 1976 to 1977, he served as the Assistant Director for National Security Affairs of the Office of Science and Technology Policy, Executive Office of the President. He was Director of the Science and Technology Policy Office at the National Science Foundation from 1973 to 1976 and was a Senior Staff Assistant in the Office of Science and Technology from 1965 to 1972. He is currently President of Science and Technology Consultants, a small business involved with development of scientific instruments and technical consulting services.

Dr. Drew is the 1984 IEEE Vice President for Professional Activities and Chairman of the United States Activities Board (USAB). Prior to that, he was the 1983 chairman of the Government Activities Council of USAB, and chaired the 1982 IEEE Conference on U.S. Technology Policy. Dr. Drew specializes in Science and Technology Policy matters and application of technology to advanced instrumentation.

Mr. BROWN. We will look forward to continuing with our close communications and cooperation with you.

To illustrate how flexible this Subcommittee is, before we question this panel, I am going to ask one member of the next panel to come up who has a time problem and must leave.

Dr. Kerber, could you pull up a chair at the end here? We appreciate your willingness to show your flexibility in this regard by presenting your statement and then we will have a chance to question you at least briefly and then the rest of the panel before we take up the last panel which is basically relating to the chip situation.

STATEMENT OF RONALD L. KERBER, DEPUTY UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ADVANCED TECHNOLOGY, DEPARTMENT OF DEFENSE, ACCOMPANIED BY EGBERT MAYNARD, DIRECTOR OF COMPUTER AND ELECTRONICS TECHNOLOGY

Dr. KERBER. Thank you, Mr. Chairman and members of the Committee. I appreciate your flexibility in allowing me to appear before you at this time.

I want to discuss today the growing problem of U.S. dependency on foreign suppliers for semiconductors used in weapon systems and the problems associated with the long term viability of this segment of the U.S. industrial base to continue to be the principal supplier of electronics for the Department of Defense and its systems contractors.

In fact, I have with me today Mr. Egbert Maynard, Director of Computer and Electronics Technology for the purpose of answering questions you may have in his particular area of expertise.

I also have a prepared statement which I would like to submit for the record.

Mr. BROWN. Without objection, the statement will appear in full. Would your colleague be able to stay after you have left?

Dr. KERBER. Yes.

First, I would like to provide you with a summary of the recent findings of the Defense Science Board which addressed the importance of the semiconductor industry to economic strength and national security. Secondly, I would like to address specific areas of interest to the panel concerning potential private and public efforts to address the problems.

In December 1985, the Defense Science Board was requested to organize a task force to address the impact of the dependency of the U.S. military on foreign sources for semiconductor devices. The task force was chaired by Mr. Norman Augustine, president of Martin-Marietta Corp., and recently completed a 10 month effort during which it solicited input from all interested parties.

The task force concluded that while our dependency on foreign sources is modest today, semiconductor manufacturing trends indicate that we will soon become highly dependent on foreign sources if immediate actions are not taken. The most significant finding of the task force was that semiconductor technology leadership is rapidly eroding which has serious implications on the nation's economy and national security.

In their words,

> The U.S. defense strategy lies upon technologically superior weapons to overcome the numerical advantage of our adversaries. Our capability to field technologically superior weapons may soon be dangerously eroded. The superiority of defense systems of all types is directly dependent upon superior electronics, a force multiplier which not only enhances the performance of the weapon systems themselves, but also maximizes the efficiency of their application through sophisticated intelligence, communication and command and control. Electronics technology is the foundation upon which much of our defense strategy and capabilities are built. The U.S. has historically been the technology leader in electronics. Superiority in the application of innovation no longer exists and the relative stature of our technology base in this area is steadily deteriorating.

In the 1960's, the Department of Defense was the dominant procurer of semiconductors in the United States and it was because of this fortuitous synergism that existed between the needs of the Defense Department and the semiconductor industry that it was able to grow so rapidly.

Today, the U.S. military acquires less than 3 percent of the quantity output of the semiconductor industry. Although semiconductors are of major importance to national security, the defense market is not of great importance to the semiconductor industry.

A number of technologies contribute to maintaining the strength of modern military forces. However, electronics gives us the ability to sense, locate, acquire, track, identify and destroy potential targets. It sorts and assimilates and computes complex data in real time. It allows us to aim, launch and guide various munitions with precise accuracy anywhere in the world. It extends the minds and muscle of our military personnel so they may continue to serve as a deterrent to potential adversaries.

Significant gains in military capability have been achieved by the application of modern electronics technology. For example, sensors have more than doubled missile warning time and greatly expanded geographical coverage. Light weight electronics permitted the creation of airborne radar capable of monitoring over 1 million cubic miles of airspace from a single platform. Electro-optic fire control systems now enable tactical attack aircraft to engage several targets on a single pass, and, finally, electronics technology has impacted traditional weapon systems.

Recent armor advances include the ability to fight at night using only passive sensors, to shoot while moving and to hit targets at extended ranges with only one round.

The world market for electronics including computers, telecommunications equipment, consumer products, industrial process control equipment, scientific instruments and defense systems, has grown at an extraordinary rate over the last three decades. This market reached $200 billion in 1983, more than doubling the 1977 figure.

In the 1990's, the world market for electronics is expected to be around $500 billion growing to over $1 trillion by the year 2000. This figure places electronics, already the number one employer in the U.S., with over 2.5 million jobs, as one of the world's leading industries. In 1987, the world market for integrated circuits is expected to approach $30 billion. This dollar value only partly reflects the importance of semiconductors in transforming modern industrial society.

They have played a central role in the development of new industries such as data processing, robotics and much of the consumer electronics market. This technology is the key to information processing, communication and computing technology which is vitally critical to national security and economic well being.

The findings of the Defense Science Board on the cause of this trend are, not surprisingly, nearly all related to the competition from Japan. Japanese aggressiveness has elevated them from a 20-percent market share to world leadership and domination in one decade.

Neither the Department nor the Defense Science Board intend this report to be interpreted as anti-Japanese. On the contrary, the Japanese are to be commended for having the foresight and fortitude to focus their national resources on an industry and a technology which is so fundamental to leadership in electronics and is the enabling technology for automated manufacturing, the key to manufacturing excellence. However, the impact of their successful strategy on U.S. industry cannot be ignored.

The Defense Science Board has made specific recommendations to the Department which they felt would redress the effects of current trends on U.S. military capability. These recommendations are; first, support the establishment of a Semiconductor Manufacturing Technology Institute; second, establish centers of excellence in semiconductor science and engineering; third, increase emphasis in the Department on the technology base program; fourth, provide discretionary R&D credits to defense semiconductor parts suppliers; and finally, establish a Government/industry/university forum on semiconductors to facilitate joint action in semiconductor research, development and manufacturing.

I must point out that the Defense Science Board's recommendations were tailored to actions that the Department must take to redress the impact on defense. These actions alone will not solve all the problems facing the industry. If we are to avoid a situation where the Defense Department must perpetually sustain an expensive defense-only capability, it is imperative that action be taken by the Department, other Government agencies, and most importantly, by the industry itself, which will re-vitalize the industry to a point where healthy competitive U.S. corporations once again produce in the private sector the technology we need to assure the best military capability.

The Department has always had access to leading semiconductor technology and this has contributed significantly to our military strength. The decline of this technology is a new experience and we are working to define the proper role that the Department and the Government should take to resolve what basically constitutes an industry problem.

Much of what needs to be done to improve U.S. semiconductor competitiveness rests in the private sector. Productivity is the responsibility of management and labor, as are product and market strategies that address global markets. Government cannot legislate competitive success.

Historically, Government organizations have aggressively supported the development of science and technology in accordance with their respective missions. Much of this work has been performed in industry and is partly responsible for the foundation of knowledge that has kept the U.S. in a technical leadership position. This R&D is important to create not only new products but also new industrial processes and manufacturing systems. These can greatly increase industrial productivity, reduce costs and improve quality of products.

The research behind such advances is carried out in our nation's laboratories, by industry, by Government and by universities. We must provide the support, incentives and environment that ensure success in all three, individually and cooperatively.

The Department considers technology leadership in semiconductors and electronic devices as essential to the development and maintenance of forces equipped with technically superior equipment. To ensure this leadership into the next century, it is necessary that the nation conduct a vigorous research and development program in the science and engineering required to acquire the manufacturing tools and processes needed for future excellence.

In fact, the VHSIC program has begun to do this in a limited way with x-ray lithography and laser pantography. However, a defense—only strategy is not desirable.

We are working closely with representatives from other Federal agencies such as the Department of Energy, the National Science Foundation, and the Office of Science and Technology Policy, to ensure that the use of resources are optimized. Inter-agency coordination is an important ingredient for future success.

Government, of course, is not the solution to the problem. It can best serve as the catalyst. The solution lies within the industry. The Department is in close communication with industry in an effort to develop a strategy that provides for a healthy semiconductor sector that enjoys undisputed world leadership. However, we are keenly aware of the dangers inherent in Government providing an industrial crutch that could in the long-term inhibit attainment of a strong competitive position. The Department's actions will be in consonance with this view.

In conclusion, semiconductors are critical to the nation's economy and national security. We are working very hard to develop a strategy that satisfies our military goals and we appreciate this Committee's interest in the subject.

I would be happy to answer any questions you have.

[The prepared statement of Dr. Ronald L. Kerber follows:]

Mr. Chairman and Members of the Committee:

I am Ronald L. Kerber, Deputy Under Secretary of Defense for Research and Advanced Technology. I appreciate the opportunity to appear before the Committee today to discuss the growing problem of U.S. dependency on foreign suppliers for semiconductors used in weapon systems and the problems associated with the long-term viability of this segment of the U.S. industrial base to continue to be the principal supplier of electronics to the Department of Defense and its system contractors. I have with me today Mr. Egbert Maynard, Director of Computer and Electronics Technology, for the purpose of answering any questions that you may have with particular reference to his area of responsibility.

I have a brief prepared statement which I would like to present to the Committee.

The information which I share with you today has created strong interest among government and industrial leaders who recognize the need to implement innovative approaches to support an industry critical for U.S. economic and military leadership.

First, I would like to provide you with a summary of the recent findings of the Defense Science Board which address the importance of the semiconductor industry to future competitiveness and national security. Secondly, I would like to address specific areas of interest to the panel concerning potential private and public efforts to address the problems.

In December 1985, the Defense Science Board was requested to organize a Task Force to address the impact of dependency of the U.S. military on foreign sources for semiconductor devices. The Task Force, chaired by Mr. Norman Augustine, President of Martin-Marietta Corporation, recently completed a 10-month effort during which it solicited input from all interested parties.

The Task Force concluded that while our dependency on foreign sources is modest today, semiconductor manufacturing trends indicate that we will become highly dependent on foreign sources soon if immediate actions are not taken. The most significant finding of the Task Force was that U.S. semiconductor technology leadership is rapidly eroding and that this has serious implications for the nation's economy and national security. In their words, "U.S. Defense strategy relies upon technologically superior weapons to overcome the numerical advantage of our adversaries. Our capability to field technologically superior weapons may soon, however, be dangerously diminished. The superiority of U.S. defense systems of all types is directly dependent upon superior electronics, a force multiplier which not only enhances the performance of the weapon systems themselves, but also maximizes the efficiency of their application through sophisticated intelligence and command

and control systems. Electronics technology is therefore the foundation upon which much of our defense strategy and capabilities are built. The United States has historically been the technological leader in electronics. However, superiority in the application of innovation no longer exists and the relative stature of our technology base in this area is steadily deteriorating."

In the 1960's, the Department of Defense was the dominant procurer of semiconductors in the United States and it was because of a fortuitous synergism that existed between the needs of the private sector and defense that the semiconductor industry was able to grow so rapidly. Today, however, the U.S. military acquires less than three percent of the quantity output of the semiconductor industry. Thus, although semiconductors are of major importance to the national security, the Defense market is not of great importance to the semiconductor industry.

A number of technologies contribute to maintaining the strength of modern military forces. However, electronics gives us the ability to sense, locate, acquire, track, identify and destroy potential targets. It sorts, compiles, assimilates, and computes wide varieties of complex real-time data. It allows us to aim, launch, and guide various munitions with precise accuracy anywhere in the world and under any conditions. It extends the minds and muscle of our military personnel so that they may continue to serve as a deterrent to potential adversaries.

Significant gains in military capability have been achieved by the application of modern electronics technology. For example, sensors have more than doubled missile warning time and greatly expanded geographical coverage. Lightweight electronics has permitted the creation of airborne radar capable of monitoring over one million cubic miles of airspace from a single platform. Electro-optical fire control systems now enable tactical attack aircraft to engage several targets on a single pass even during night-time conditions. And finally, electronics technology has impacted traditional weapon systems. Recent armor advances include the ability to fight at night using only passive sensors, to shoot while moving, and to hit targets at extended ranges with the first round, thereby reducing exposure to hostile fire.

The world market for electronics - including computers, telecommunications equipment, consumer products, industrial process control equipment, scientific instruments and defense systems - has grown at an extraordinary rate over the last three decades. This market reached $200 billion in 1983, more than doubling the 1977 figure. In the 1990's, the world market for electronics is expected to be around $500 billion growing to over a trillion dollars by the year 2000. This figure places electronics, already the number one employer in the U.S. with over two and one-half million jobs, as one of the world's leading industries.

Semiconductor chips offer numerous advantages including small size, low cost, minimal power demand, high reliability, and very high speed. They have been referred to, not inappropriately, as "industrial rice" or as the "crude oil of the Information Age". In 1987, the world market for integrated circuits is expected to approach $30 billion. This dollar value only partly reflects the importance of semiconductors in transforming modern industrial society. They have played a central role in the development of new industries such as data processing, robotics, and much of the consumer electronics market. Since the 1960's, semiconductors have fundamentally altered communications, education, health care, recreation, entertainment, and work activity. This technology is the key to information processing, communication, and computing technology which is vitally critical to national security and economic well being.

The findings of the Defense Science Board on the cause of this trend are, not surprisingly, nearly all related to competition from Japan. Japanese aggressiveness has elevated them from a 20 percent market share to world leadership and domination in one decade.

Neither the Department nor the Defense Science Board intend this report to be interpreted as anti-Japanese. On the contrary, the Japanese are to be commended for having the foresight and fortitude to focus their national resources on an industry and a technology which is so fundamental to leadership in electronics and is the enabling technology for automated manufacturing - the key to manufacturing excellence. However, the impact of their successful strategy on U.S. industry can not be ignored.

The Defense Science Board has made specific recommendations to the Department which they felt would redress the effects of current trends on U.S. military capability. They are: 1) support the establishment of a Semiconductor Manufacturing Technology Institute, 2) establish centers of excellence in semiconductor science and engineering, 3) increase emphasis in DoD technology base programs, 4) provide discretionary R&D credits to defense semiconductor parts suppliers and 5) Establish a government/industry/university forum on semiconductors to facilitate joint action in semiconductor research, development and manufacturing.

I must point out that the Defense Science Board's recommendations were tailored to actions that the Department must take to redress the impact on Defense. As they point out, these actions alone will not solve all the problems facing the industry. If we are to avoid a situation where the Defense budget must perpetually sustain an expensive "Defense only" semiconductor capability, it is imperative that action must be taken by the Department, other government agencies and most importantly by the industry itself, which would revitalize the industry to a point where healthy, competitive U.S. corporations once again produce in the private sector the technology we need to assure the best military capability.

The Department of Defense has always had access to leading semiconductor technology and this has contributed significantly to the strength of our military forces. The decline of this technology is a new experience for us and we are working to define the proper role that the Department and/or Federal Government should take to resolve what basically constitutes an industry problem. Much of what needs to be done to improve U.S. semiconductor competitiveness rests in the private sector. Productivity is the responsibility of management and labor, as are the product and market strategies that address global markets. Government cannot legislate competitive success. However, Government does have a legitimate role.

Historically, government organizations have aggressively supported the development of science and technology in accordance with their respective missions. Much of this work has been performed in industry and is partly responsible for the foundation of knowledge that has kept the U.S. in a technical leadership position. This R&D is important to create not only new products but also new industrial processes and manufacturing systems. These can greatly increase industrial productivity, reduce costs, and improve quality of products. Advances in semiconductors are influencing the production of steel, automobiles and a wide variety of other manufactured goods. The research behind such advances is carried out in our Nation's laboratories - by industry, by government, and by universities. We must provide the support, incentives, and environment that ensure success by all three, individually and cooperatively.

To accomplish these goals the public and private sector needs to be better coordinated. The Department considers technology leadership in semiconductors and electronic devices as essential to the development and maintenance of forces equipped with technically superior equipment. To ensure this leadership into the next century, it is necessary that the nation conduct a vigorous research and development program in the science and engineering required to avail the country the manufacturing tools and processes required for future excellence. In fact the VHSIC program has begun to do this in a limited way with x-ray lithography and laser pantography. However, a "Defense only" strategy is not desirable.

We are working closely with representatives from other federal agencies such as the Department of Energy, the National Science Foundation, the Office of Science and Technology Policy and the Economic Policy Council to ensure that the use of resources are optimized. Inter-agency coordination is an important ingredient for future success.

Government, of course, is not the solution to the problem. It can best serve as the catalyst. The solution lies within the private sector and industry in particular. The Department is in close communication with industry in an effort to develop a strategy that provides for a healthy semiconductor sector that enjoys undisputed world leadership. However, we are keenly aware of the dangers inherent in government providing an industrial crutch that could in the long term inhibit attainment of a strong competitive position. The Department's actions will be in consonance with this view.

In conclusion, semiconductors are critical to the nation's economy and national security. We are working very hard to develop a strategy that satisfies our military goals. We appreciate your Committee's interest in this subject.

I appreciate this opportunity to appear before the Committee and shall be happy to answer any questions you may have.

Mr. **Brown**. I recognize that you have to leave very shortly. We won't keep you very long.

I want to relate your testimony to the testimony of the three previous witnesses, all of whom emphasized the fact that where we have made in the past a number of efforts, which Dr. Drew pointed out, to develop this strong technological base and maintain our technological leadership, the missing ingredient has been an overarching policy which gave adequate priority to this and which brought together not just one crisis area but makes an effort to encompass all of the needs of our economic and industrial structure.

I commend the Department of Defense for the initiative they have shown here, but you have said yourself that a defense-only policy doesn't solve the needs of the larger society and you indicated steps you are taking to move beyond a defense-only policy.

The question is whether those steps, important as they are, will provide the necessary structure to maintain our leadership across the board.

Dr. Rosenstein, for example, although he had a slip of the tongue, referred to the superconductor situation as well as the semiconductor situation and the speed with which the Japanese have rushed into this challenging and exciting new area of technology. There are many other areas in the materials field and the electronics field and so on.

Do you feel that the Defense Department on its own initiative, admirable as its efforts are, is going to be able to provide the mechanism to meet the total needs for competitiveness in our industrial structure?

Dr. **Kerber**. I don't think that is the goal of the Defense Department. However, I would say both in this position in the Federal Government and in my previous positions with other Federal agencies, the National Science Foundation, the Department of Energy, that the research programs we have in those areas are very well coordinated and I feel very strongly about the role Defense needs to play in order to meet its own technological needs and to ensure that we are developing the technology in defense that is important for its needs.

That gives us several advantages. First of all, assurance that we have the technology that we need. Second, assurance that the people who exploit technology in defense are aware of the technology as it is being developed.

I think it is very important to recognize that mission-oriented agencies need to be aggressively developing technology which is, in fact, a broader spectrum in application than just their needs.

Mr. **Brown**. Mr. Walgren, do you have any questions before Dr. Kerber has to leave?

Mr. **Walgren**. The lines are so hard to draw in this area. I can't help but wonder when you say the Japanese should be commended for having the fortitude to focus their national resources on this area, whether by implication we are not to be commended for failing to focus our national resources on this area.

Dr. **Kerber**. I didn't mean to imply that. What I think we really need to do is recognize the criticality of something like electronics technology and its importance both to national security and to the economic well being of the country.

Mr. **Walgren**. As you know, our problem is that many parts of our society don't recognize the things we have to do in order to make these things happen. You always wonder where they lie. I noticed you left out one sentence that did appear in the written text, when you say that Government cannot legislate competitive success, and that was said, but what was not said was what followed, "However, Government does have a legitimate role."

Who decided to leave that out? [Laughter.]

Dr. **Kerber**. Sir, I was making my statement as short as possible. [Laughter.]

Mr. **Walgren**. Thank you, Mr. Chairman.

Mr. **Brown**. Dr. Kerber, I want to thank you for your testimony. And I know the other members of the committee would like to ask you some questions, but if you will leave your colleague here to participate with the next panel, I think we may want to go more deeply into this semiconductor industry; and I would be glad to excuse you at this time.

Dr. **Kerber**. Thank you.

Mr. **Brown**. And, Mr. Walgren, I wonder if you would resume the Chair, and we're ready to question this panel now.

Mr. **Walgren** [presiding]. Well, let me recognize Mr. Brown at this point because he has to go shortly I understand. Is there further discussion you would like to raise at this point?

Mr. **Brown**. Well, Mr. Chairman, I don't want to belabor the details of this. I want to focus on the broader picture as much as possible.

And I was interested in Dr. Drew's conclusions that perhaps it is premature to move toward a Department of Science and Technology. At least you are somewhat more ambiguous of it now. But the step represented by developing a specific institutional arrangement such as the Policy and Technology Foundation which would be charged with looking at the overall government-wide policy aspects, and to be given the tools and the resources is perhaps the more appropriate step at this time. Even this step is a fairly significant move, as you recognize.

I'm wondering if you think we have finally reached that critical point—you might say critical mass—where it's clear that we do have to take a step of this magnitude in order to focus our national efforts effectively on this whole national problem of competitiveness.

Are we at the point where this is a politically feasible thing to do? Can we get public support for it?

Dr. **Drew**. Mr. Brown, I believe that we're approaching that point. I'm not sure that we're there yet. I mentioned the Vannevar Bush report because I have seen so often in the past a building perception of a problem which needs then some catalyst to just sort of trigger what has been building up.

We saw that in Rachel Carlson's *Silent Spring*, if you will. You know, I saw EPA in our environmental legislation just sort of grow out of that event which sort of triggered a series of growing perceptions in the public and private sector.

I think we have now the growing public and private sector perception of a major national crisis. And I wish I had the golden pen to trigger that. I don't know whether this bill quite fills that bill, but I'm very hopeful that—in this process now of focusing on the—an institutional structure, a rationale which sort of supports that and says, we really have to do things differently.

When I said, new era, we have profited tremendously by this, making industry tough enough and independent enough, and to, you know, fight off the government regulators and fight off the competitors and so on.

And it's not clear that the international marketplace today, with the competitors we have, will continue to give U.S. industry the necessary opportunities unless we find a new way to support our industrial capability. And that's the thing I think we need.

Mr. BROWN. Just one final question. You suggested that there might be a historical role for the Science and Technology Policy Task Force that this committee has set up to focus on this and to make recommendations which possibly can come out later this year, if we move rapidly enough.

Do you see this as making a contribution to this development of a critical mass of support, so that we could do as we did after the Vannevar Bush report, create an institution—in that case the National Science Foundation—to really put us back on track again?

Dr. DREW. I would hope so. The only reservation I have is that time is passing by very, very rapidly. I say delay is of concern. But I think you have to strike them when you just get to the right point. I was hoping that, in the context of your study, that more of the refinement that I think is needed, and more consensus building will occur to get us to the trigger point and then we can take action.

Mr. BROWN. Well, I thank you for your contribution.

Mr. WALGREN. Thank you, Mr. Brown.

The Chair recognizes Mr. Price.

Mr. PRICE. Thank you, Mr. Chairman. I appreciate the fine testimony. I have no questions at this time.

Mr. WALGREN. Mr. Valentine.

Mr. VALENTINE. Mr. Chairman.

I would like to ask these three gentlemen a general question. It has to do with H.R. 2191, a bill which I introduced yesterday, which has several very prominent and learned cosponsors. It is designed to create a National Advisory Committee on Semiconductors. And it would create a 13-member committee, including the Secretary of Defense, the Secretary of Commerce, the Secretary of Energy, the Director of the Office of Science and Technology Policy, the Director of the National Science Foundation, four members from the semiconductor industry, and four members from outside of government.

And it would have the task of monitoring competitiveness in this area and determining the technical areas where the United States is deficient, and other matters, and making recommendations.

I don't know whether you can make a judgment based on what I have said here; if not, I would appreciate it if you would look at this legislation and respond to me, because I am interested in knowing how you feel about it.

We didn't take this initiative just to make a symbolic gesture, so to speak. We want to try to do something about a problem which people tell me will probably result in this nation being a second-class power early in the next century, militarily and economically, unless we address it.

End of speech.

[The bill H.R. 2191 follows:]

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100TH CONGRESS
1ST SESSION

H. R. 2191

To advance the national leadership in semiconductor technology, to establish a National Advisory Committee on Semiconductors, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

APRIL 28, 1987

Mr. VALENTINE (for himself, Mr. RITTER, Mr. PRICE of North Carolina, Mr. PERKINS, Mr. DYMALLY, Mr. MINETA, Mr. BROWN of California, and Mr. SCHEUER) introduced the following bill; which was referred to the Committee on Science, Space, and Technology

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A BILL

To advance the national leadership in semiconductor technology, to establish a National Advisory Committee on Semiconductors, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "National Advisory Committee on Semiconductor Research and Development Act of 1987".

SEC. 2. PURPOSES.

(a) GENERAL FINDINGS.—The Congress finds and declares that—

(1) our future economic status is firmly wedded to leadership in the high technology industries that depend upon semiconductors;

(2) the leadership position of this country in high technology areas is threatened by the changing nature of foreign competition which is often strongly supported by the national governments involved;

(3) our national defense is highly dependent upon the availability of leading edge semiconductor devices, and it is counter to the national interest to be dependent upon foreign sources for this technology;

(4) governmental actions to address these issues are fragmented in many Federal departments and agencies; and

(5) responses to these challenges require concerted actions of industry and government.

(b) SPECIFIC PURPOSES.—The purposes of this Act are—

(1) to establish the National Advisory Committee on Semiconductors; and

(2) to assign to such Committee the responsibility for devising and promulgating a national semiconductor strategy, including research and development, the implementation of which will assure the continued leadership of the United States in semiconductor technology.

SEC. 3. ESTABLISHMENT OF THE NATIONAL ADVISORY COMMITTEE ON SEMICONDUCTORS.

There is hereby created in the executive branch of the Government an independent advisory body to be known as the National Advisory Committee on Semiconductors (hereinafter referred to as the "Committee").

SEC. 4. FUNCTIONS OF THE COMMITTEE.

(a) IN GENERAL.—The Committee shall—

(1) collect and analyze information on the needs and capabilities of industry, the Federal Government, and the scientific and research communities related to semiconductor technology;

(2) identify the components of a successful national semiconductor strategy in accordance with section 2(b)(2);

(3) analyze options, establish priorities, and recommend roles for participants in the national strategy; and

(4) provide results and recommendations to agencies of the Federal Government involved in legislative, policymaking, administrative, management, planning, and technology activities that affect or are part of a national semiconductor strategy, and to the industry and other nongovernmental groups or organizations affected by or contributing to that strategy.

(b) **Specific Functions.**—In fulfilling this responsibility, the Committee shall—

(1) monitor the competitiveness of the United States semiconductor technology base;

(2) determine technical areas where United States semiconductor technology is deficient relative to international competition;

(3) identify new or emerging semiconductor technologies that will impact the national defense or United States competitiveness or both;

(4) develop research and development strategies, tactics, and plans whose execution will assure United States semiconductor competitiveness; and

(5) recommend appropriate actions that support the national semiconductor strategy.

SEC. 5. ORGANIZATIONAL AND ADMINISTRATIVE PROVISIONS.

(a) **Membership.**—(1) The Committee shall be composed of 13 members, 7 of whom shall constitute a quorum.

(2) The Secretary of Defense, the Secretary of Commerce, the Secretary of Energy, the Director of the Office of Science and Technology Policy, and the Director of the National Science Foundation, or their designees, shall serve as members of the Committee.

(3) The President shall appoint, as additional members of the Committee, 4 members from outside the Federal Gov-

ernment who are eminent in the semiconductor industry, and 4 members from outside the Federal Government who are eminent in the fields of technology, defense, and economic development.

(4) One of the members appointed under paragraph (3), as designated by the President at the time of appointment, shall be chairman of the Committee.

(b) Staff Support.—Administrative support for the Committee shall be provided through an arrangement with an appropriate agency or organization designated by the Committee. The funds necessary for such support shall be provided to the designated agency or organization, from sums available to the Committee to carry out the purposes of this Act, in accordance with a memorandum of understanding entered into between them.

(c) Expenses.—Members of the Committee, other than full-time employees of the Federal Government, while attending meetings of the Committee or otherwise performing duties at the request of the Chairman while away from their homes or regular places of business, shall be allowed travel expenses in accordance with subchapter I of chapter 57 of title 5, United States Code.

(d) First Meeting.—The Chairman shall call the first meeting of the Committee not later than 90 days after the date of the enactment of this Act.

(e) REPORTS.—At the close of each fiscal year the Committee shall submit to the President and the Congress a report on its activities conducted during such year and its planned activities for the coming year, including specific findings and recommendations with respect to the national semiconductor strategy devised and promulgated under section 2(b)(2). Each report shall include an estimate of the length of time the Committee must continue before the achievement of its purposes and the issuance of its final report.

SEC. 6. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to carry out the purposes of this Act such sums as may be necessary for the fiscal years 1988, 1989, and 1990. Appropriations for any fiscal year pursuant to the preceding sentence shall be made through a specific line item in the Act making appropriations to the National Science Foundation for that year.

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Dr. Rosenstein. I believe that your initiative, without having read it, sounds like something that is surely needed, as the semiconductor industry is under attack. And unless we have means to, not only examine what must be done immediately, but to have some foresight and some vision of the future, we will continue to regress.

We need this across the board. What we're doing in this country is reacting at the 11th hour. We need a standing mechanism, a series of councils which will be looking at the entire breadth of industry opportunities, and envision not only the opportunities, but the problems of the future.

For example, we were in Japan five years ago and we examined what MITI did. They have 16 national laboratories which are devoted to supporting industry. We have essentially none other than that of aeronautics.

One of their laboratories was a fermentation laboratory, and I thought, my that's nice, they're going to have the best saki in the world. What suddenly dawned upon me, that the production process for bio-engineered products is fermentation. Five years ago they were busily putting in place the production technology to take over the fermentation industry. They are doing the same thing in optoelectronics which is going to be a $100 billion industry. We're very proud of what we're doing in one of the mainstays of our economy, that is building.

I can predict within five years the Japanese building industry is going to be sending prefabricated houses to this country, because they have put in place mechanisms to economically and efficiently produce houses.

I believe that what you propose is important for the semiconductor industry, because it is certainly a lynchpin of much of our economy. But I think we need a broad mechanism to look at the future lynchpins of our economy.

Mr. Valentine. Thank you. Do either one of you other gentlemen care to comment?

Dr. Drew. Well, I would certainly second the importance of this focus. Dr. Kerber, I think, adequately described the tremendous importance, not only to defense, but across the board of this particular area.

There are ad hoc mechanisms that arise. I mentioned the IEEE's effort to define, and it turns out optoelectronics focus—there are groups, the semiconductor industry has certainly been acutely sensitive to this. Providing a forum to bring these things together is probably, without knowing all of the details, a valuable step. I think it is timely. But I would certainly second what Dr. Rosenstein said about—it's systematic of, in fact, a number of areas where we probably need to bring that focus together.

Mr. Winkelman. May I add a comment, Mr. Chairman. I, too, feel that it's a step in the right direction, but in my view too small.

I think we finally have to come to grips in this country with the basic question, and that is, to promote a working arrangement with business, labor, government and educators to come to grips with the fundamental problems and to look out ahead of ourselves to anticipate the problems instead of reacting after the fact.

And while—what you're talking about, and it may well be needed, it is still reacting to the current situation and not looking ahead to the year 2000 or beyond where we have to have mechanisms to move much more rapidly as is illustrated by Dr. Rosenstein's comment about superconductivity.

The Japanese aren't waiting to set up some intergovernmental committee to advise. They've got action.

Now, one of our problems, also, is our focus, and believe me I come from a private enterprise system. We're so busy worrying about competition among our own companies within the country that we have lost track of the fact that the major competition is with other countries and not within ourselves. And therefore, we need to find mechanisms to deal with the problems of auto safety ahead of time. To deal with the problems of a gasoline crisis when it arises. To deal with the problems of garbage and waste disposal. We can't wait, and we can't deal with them one by one as they come up and after the fact.

Mr. **Valentine**. I don't have any further questions, Mr. Chairman.

Mr. **Walgren**. I appreciate those responses.

Mr. Mineta.

Mr. **Mineta**. Mr. Chairman, I have no questions of this panel.

Mr. **Walgren**. Mr. Ritter.

Mr. **Ritter**. Mr. Chairman, I have no questions.

Mr. **Walgren**. Well, let me on behalf of the committee thank you very much for your participation in this. It's a frustrating area, and I hope we can learn something about it. Thank you very much.

Let's call the third panel. And the gentleman accompanying Dr. Kerber, but then also we have Larry Summney, the President of Semiconductor Research Corporation; Mr. Charles Sporck, President of National Semiconductor Corporation.

I want to recognize, first, Mr. Valentine for an introduction of Mr. Sumney who must come from North Carolina; and Mr. Mineta for an introduction of Mr. Sporck.

Mr. **Valentine**. Thank you, Mr. Chairman. I'm sorry that you don't look at me as an international figure. Just because I want to introduce him he must come from North Carolina, but that's okay. He makes up for that deficiency.

Mr. Chairman and members of the committee, one of the witnesses today, as you have pointed out, is Mr. Larry Sumney, President of Semiconductor Research Corporation in the Research Triangle Park in North Carolina.

Mr. Sumney has participated in many discussions on the management of research and technology needs of the nation; and on the semiconductor issues now facing this country.

He is current Chairman of the National Research Council Steering Group on semiconductor industry and DOE National Laboratories; and was a member of the Defense Science Task Force on semiconductor dependency. He has served in many other capacities.

Mr. **Walgren**. Well, I appreciate that very much. I could impose on the gentleman from North Carolina to come and chair this panel.

Mr. **Valentine** [presiding]. First of all, Mr. Price, do you care to make a statement at this time?

Mr. **Price**. Well, I would just like to add my word of welcome to Mr. Sumney and thank him for his leadership in our state and we look forward to hearing his statement. And I'll have some questions after he offers that testimony.

Mr. **Valentine**. Mr. Ritter, do you have any statement you would like to make?

Mr. **Ritter**. No. I welcome our witnesses and look forward to hearing them.

Mr. **Valentine**. All right. I believe the first witness is Mr. Larry Sumney. Mr. Sumney, we are happy to have you here and you recognize, I'm sure, that we have certain time constraints. We want you to have an opportunity to express yourself adequately. The statement which you have submitted will be filed and will be a part of the record in toto, and you may summarize or proceed in any manner that you deem appropriate.

STATEMENTS OF LARRY SUMNEY, PRESIDENT SEMICONDUCTOR RESEARCH CORP., RESEARCH TRIANGLE PARK, NC; CHARLES E. SPORCK, PRESIDENT, NATIONAL SEMICONDUCTOR CORP., SANTA CLARA, CA; AND, CHARLES H. FERGUSON, CENTER FOR TECHNOLOGY POLICY AND INDUSTRIAL DEVELOPMENT, MIT, CAMBRIDGE

Mr. **Sumney**. Thank you very much, Mr. Chairman and distinguished members of the committee. My name is Larry Sumney and I am president of the Semiconductor Research Corp. based in the Research Triangle Park of North Carolina.

Semiconductor Research Corporation often knows as the SRC was begun 5 years ago by the Semiconductor Industry Association as an industry sponsored cooperative effort in generic semiconductor research.

I think we have been reasonably successful. By the end of this year over 60 participating companies will have made over $100 million available to support an integrated semiconductor research program that involves over 40 U.S. universities, several hundred faculty members, and over 400 graduate students.

In 1986 the Federal Government became a financial participant in the SRC for the first time. We're proud of our research program, but we recognize that it is only one component of a solution to the problem being addressed in these hearings today.

In the debate on industrial competitiveness the U.S. semiconductor industry emerges as a focal point of discussion because it is the critical leverage point to renew American competitiveness in many other downstream industries, and because it now faces serious challenges from foreign competition.

A national strategy is vitally important to those of us who agree with a recent Defense Science Board report that, "Semiconductors truly are the industrial rice of the information age."

As we lose our leadership in semiconductors, we are going to lose a mainstay of our economic and military security.

I appreciate this opportunity to participate in your hearings on the role of science and technology and competitiveness. Others on the panel will discuss in detail the present status of the semiconductor industry in the United States and its importance to both our national economy and our national defense.

In addition, you will hear details of a major new industry initiative, SEMATECH, which is also of paramount importance to our defense community, and is indeed, a part of an overall national strategy to regain competitive posture.

SEMATECH stands for Semiconductor Manufacturing Technology, and it is designed to address the U.S. lag in this critical area.

My prepared statement has been made available to you, and I would like to focus my brief comments on a key element of the national strategy that we must implement if we are to regain our leadership position.

Many activities that seek to address the semiconductor problem are underway, are being planned, or are being proposed. The Semiconductor Research Corporation is indeed a successful example. The Department of Defense's Very High Speed Integrated Circuits program, and now the new Monolithic Microwave Integrated Circuits program, both address specific defense needs.

Individual companies fund and conduct extensive research, and the industry is now working on SEMATECH as a proposed cooperative effort. This is also a high priority recommendation of the Department of Defense.

Within the Department of Energy a National Laboratory Semiconductor initiative is being discussed. Our great universities and individual state programs address elements of the problem. Other proposals have also been made.

Our concern is that all of these programs and proposals, while good and rational in isolation are uncoordinated and often overlapped when viewed as part of an overall plan to address the serious national problem. Our technology resources are being inefficiently used. The whole has been less than some of the parts.

A coherent strategy that ties the many programs and players together is essential if the nation is going to make the best use of its resources that are available to us, and if it intends to succeed.

In 1918 we declared it was our national intent to establish and maintain U.S. leadership in the field of aviation. We support this intent through the creation of the National Advisory Committee on Aeronautics, and through substantial continuing R&D of the government in support of both commercial and defense aviation. The result has been U.S. leadership through seven decades of aviation history.

Today, a similar resolve is needed for semiconductors, just as the aviation situation was understood and supported by the various branches of the government and by the industry, semiconductor strategy must pervade the economic trade and regulatory activities of the government; and it must generate response and cooperation from both government and industry.

A National Advisory Committee on Semiconductors composed of very knowledgeable leaders from industry and government must provide a focal point for these efforts. This group would assess our present status and future needs, and would advise both government and industry on the opportunities, the strategies, and approaches needed to reestablish and maintain our leadership in the vital semiconductor arena.

The national semiconductor strategy that would evolve from the Advisory Committee would provide the technological underpinning for a more competitive industry, an overall stronger economy, and a strong national defense.

Mr. VALENTINE. Mr. Sumney, let me interrupt you. We have a vote, and I think now is as good a time as any to break in. If you would bear with us. We'll be in recess for five minutes.

[Recess.]

Mr. VALENTINE. The committee will please be in order.

I think by the time we get settled, other members will begin to drift back in.

Mr. Sumney, you may resume.

Mr. SUMNEY. Thank you, Mr. Chairman.

The Semiconductor Industry Association has attached a reasonably high priority to the concept of the National Advisory Committee. Also, the recent report on the Defense Science Board Task Force on Defense Semiconductor Dependency concludes with a similar statement that an advisory group be established to "formulate a comprehensive and coherent strategy for legislative, administrative and management action to reverse the trend toward the export of semiconductor manufacturing and technology leadership."

In fulfilling this responsibility, the NACS would: one, monitor the competitiveness of the U.S. semiconductor technology base; two, determine technical areas where this country's semiconductor technology is deficient relative to international competition; three, identify new or emerging semiconductor technologies that impact the national defense and/or U.S. competitiveness; four, develop research and development strategies, tactics and plans whose execution would assure U.S. semiconductor competitiveness; and finally, recommend appropriate action to support the overall semiconductor strategy.

In 1987 the semiconductor industry is unique. The technology base that it provides is the key to U.S. competitiveness in the high technology industries that will dominate the world economy for the next century, and it is also the most pervasive technology in our nation's defense strategy. Without semiconductor leadership, achievement of both national security and economic goals of the nation will be difficult, if not impossible.

The problems we face are of the highest importance. They require national leadership and national solutions if we are to secure our economic competitiveness and our defense preparedness. I believe with your support and with the active participation of concerned Federal agencies working cooperatively with our industries, our great research universities, our Federal laboratories and other active and innovative programs, we can recapture and maintain our leadership position.

I have discussed these issues more thoroughly in my prepared statement. I appreciate your interest in my comments today and your concern in these very important issues. Thank you.

[The prepared statement of Larry Sumney follows:]

U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

SUBCOMMITTEE ON SCIENCE, RESEARCH, AND TECHNOLOGY

PREPARED STATEMENT OF LARRY W. SUMNEY

PRESIDENT, SEMICONDUCTOR RESEARCH CORPORATION

SEMICONDUCTOR LEADERSHIP AND NATIONAL COMPETITIVENESS

APRIL 29, 1987

Mr. Chairman and Members of the Committee:

My name is Larry W. Sumney, and I am president of the Semiconductor Research Corporation based in the Research Triangle Park, North Carolina. SRC was begun five years ago by the Semiconductor Industry Association as an industry-sponsored cooperative effort to conduct generic semiconductor research.

The SRC has been highly successful. By the end of this year, over 60 participating companies will have made over $100 million available to support an integrated semiconductor research program involving some 40 U.S. universities, several hundred faculty members, and over 400 graduate students. In 1986, the federal government became a participant in SRC for the first time.

We are proud of our program, but we recognize that it is only one component of a solution to the problem being addressed in these hearings.

America has been challenged to increase its competitiveness in order to reverse the trend toward ever rising trade deficits while maintaining a high standard of living. In the debate on industrial competitiveness, the U.S. semiconductor industry emerges as a focal point of discussion because it is the critical leverage point to renewed American competitiveness in many other industries and because it now faces serious challenges from foreign competition.

A national strategy is vitally important to those of us who agree with the recent Defense Science Board report that "semiconductors truly are 'the industrial rice' of the information age." As we lose our leadership in semiconductors, we lose a mainstay of our economic and military security.

The semiconductor industry of the United States is in danger of losing its technical leadership and market share to Japan and other competitors. The rate of decline has been rapid. Less than one decade ago, there was little challenge to U.S. leadership in this industry. Now, we are clearly behind in many of the key technologies and are being challenged in the remainder. The world market share of U.S. manufacturers is decreasing. Given the trends, this decrease will accelerate and extend to allied industries whose end products depend on advanced semiconductor components for high-end performance. With no response by the United States, the nation is headed toward becoming an also ran in the high technology sweepstakes.

The implications of this decline extend beyond the semiconductor industry and, in fact, threaten the leadership of the United States in the technologies that will determine its future military and economic status. The security and quality-of-life of future generations of Americans is clearly at issue.

It is not to late too reverse these trends and to recover the competitive edge for the United States. It is not necessarily appropriate to copy the competition to accomplish this. Their history, culture, and environment are much different. We must focus on our inherent strengths to regain our semiconductor technology leadership position. This response must be formed with knowledge of why we have the semiconductor problems in the first place.

The problems stem from two decades of only nominal international competition with U.S. leadership in high technology. This resulted in structural inefficiencies in the U.S. infrastructure, and a lack of perception by both the industry and government that the world technology competition was rapidly changing. The result, for the United States, is exemplified by:

- lack of a coherent set of industry goals.
- redundancy in research organizations and operations.
- a disaggregated industry structure with many companies too small for effective international competition.
- motivational structures that excessively reward creativity and discourage technology transfer and application of existing knowledge to solve problems.
- a society whose heroes are medical doctors and lawyers and research scientists; and not manufacturing/industrial engineers who produce the tangible products of our industry.
- an economic system that forces short-range perspectives.
- little accountability for research productivity.

These causes have been exacerbated by the emergence of foreign competitors who are strongly motivated to win markets and technological leadership from the U.S., who apply different rules and standards to the competition, and who have different government, industry, and work force characteristics arising from their different history. For example, in Japan, where catching up to the rest of the world has been the national passion for the last four decades, the heroes are the production engineers; the labor force has a strong work ethic; the society is cohesive; the industry has an integrated structure; there is a universal high priority on exports; the government gives high priority to and orchestrates industrial success; and the people, industry, and government share a protectionist stance. These ingredients have been combined to create an obviously successful competitor in the high technology arena.

For example, an annual report of ADVANTEST, a Japanese test equipment firm provides a chronological listing of important events in the company's history. It noted fourteen times in a period of eighteen years that the company had been given a subsidy, or other government funding, for the development of advanced semiconductor test equipment. During that period its negligibly small market share grew to where, finally, in 1985, ADVANTEST attained the largest share of the world market for automated test equipment. This history of patient, continuous government support of a company's efforts to obtain a successful commercial product could not be matched in the United States. In the automated test equipment market, Japan has been successful. Today, U.S. companies are purchasing ADVANTEST equipment because it is the best available.

The two remaining U.S. firms are striving to stay competitive. This type long-term focusing of resources on a particular market segment is known as targeting. It has worked in a number of areas, including semiconductor memory chips.

Some call the high technology competition a race in which the U.S. had led for so long that it became complacent. Its competitor, Japan, had to work hard to catch up. Learning how to work hard put it in a position to where, once it caught up, Japan has continued to run faster and now is leaving the United States behind in some areas. To get back into the race, we must shed the bad habits that have come from complacency and rebuild our basic strengths.

The United States has real strengths. These include our university system, industrial diversity, large monolithic market, and the demonstrated ability to respond to important challenges. We have to use these advantages to the fullest to regain competitiveness for U.S. technology.

In any case, the semiconductor industry news is not good. What does this mean? An economist might point out that the semiconductor industry is only about one percent of the gross national product so it shouldn't make much difference if it disappears. This is an irrational, but all too prevalent view. Other economists may point to the dangers of manipulating market forces in a mature economy such as that of the United States while justifying the actions of the Japanese as being necessary in their evolving economy. However, the implications of even a partial demise of the U.S. industry are severe and must be recognized. Look at national security first.

NATIONAL SECURITY

There is almost universal agreement that world-leading semiconductor technology is necessary for U.S. defense. The "force multiplier" of U.S. high technology defense systems is used to offset numerical superiority of its potential adversaries. Today, high technology resides in semiconductor electronics, integrated circuit chips. Without these components, modern aircraft cannot fly, missiles cannot be guided, and intelligence systems are useless. Loss of access to leading semiconductor technology will result in a rapid decrease in weapons-system leadership.

There is, also, almost universal agreement that we can't rely on a foreign supplier for semiconductor technology. To play such a key role in U.S. defense strategy, the supplier country would have to be politically and economically stable, responsive to U.S. defense needs for special products, willing to supply the best available technology, willing to transfer this technology to defense system suppliers, and willing to protect the technology from U.S. adversaries. If the United States were dependent on a foreign supplier for critical defense semiconductor technology, the United States would require access to the suppliers research results to use in long range defense planning, would have to install transferred technology in the United

States for highly classified applications, and would have to develop a very close relationship with the foreign supplier. These conditions cannot be met.

Some have argued that there is a way for the United States to meet its defense needs even if its semiconductor industry is no longer competitive. If there are too many conditions for a foreign source to be a viable alternative, than one can consider an "arsenal approach" where the technology leadership is maintained and defense articles are produced. This would require that the continuing effort to maintain state-of-the-art capabilities would be funded almost entirely by the government. At present, the industry spends over $2 billion annually for this purpose. This expense would be difficult for the defense effort to assume. There are also serious doubts that a government effort, even if generously funded, could compete with the drive that the commercial market gives to technology advancement. Thus, the maintenance of a world-leading industrial semiconductor technology capability appears to be required for U.S. national defense.

NATIONAL ECONOMY

In the economic sector, the implications are equally severe. As pointed out in a recent study by the National Science Foundation, world semiconductor production, valued at $30 billion in 1985, is expected to be over $120 billion by 1995. The computer industry is dependent on semiconductors for its competitiveness. In 1985, the world computer market was estimated to be $150 billion. By 1995, it should exceed $1 trillion. Other electronics intensive industries, consumer electronics, telecommunications, aerospace electronics, office automation equipment, and robotics probably will provide another $2 trillion market, dependent upon the availability of semiconductors. There is little doubt that the future economic success of the United States is wedded strongly and inseparably to these industries, and thus to semiconductors.

In commercial applications, reliance on open-market Japanese technology is not an answer. In addition to the efficiency penalties that are associated with such dependence, there is the issue of strategic technology denial brought about by the vertical integration of the component supplier. American industry cannot compete successfully if it is dependent upon the foreign companies with which it competes for the critical components that determine the performance of its products.

Thus, we see that the U.S. semiconductor industry is in trouble and that a strong competitive posture of that industry is vital to the nation. What can be done?

RECOMMENDATIONS

There have been many discussions over this past year regarding the problems the semiconductor industry and possible responses to the challenge. The Semiconductor Industry Association, a Defense Science Board Task Force, a

National Security Council working group, and others have debated issues and solutions. Although it would be somewhat misleading to say that a consensus has surfaced among all of these groups, there is a pattern of responses emerging that can be referred to as "A Winning Strategy For The U.S. In Semiconductors" or a "National Semiconductor Strategy." The remainder of my discussion introduces a framework for this strategy. It is still in the form of proposals to the industry and government leaders who will determine whether it will be put into effect.

The major components of the strategy are leadership, cooperation, funding, and a technology plan.

NATIONAL LEADERSHIP

The highest priority need is for leadership that articulates the problem, identifies goals, and proposes responses. One may speculate on why, given the significance of the problem, it has not already attracted stronger leadership. One reason is that both the administration and the industry have reservations with respect to anybody providing leadership for an industry that has been successful with free-wheeling independence in the past. A second reason is that the problem has developed rapidly -- over the last 4 or 5 years. A third reason is that the problem has a strong technical content. The difficulties and potential demise of U.S. semiconductor technology leadership are difficult to understand with a background of three decades of well-publicized success in that technology. Finally, the strong connection between semiconductor technology, on the one hand, and defense capabilities and the future economy, on the other, is not understood without considerable discussion. However, both government and industry leaders are now adding semiconductor issues to their agendas.

Many activities that seek to address the semiconductor problem are under way, being planned, or have been proposed. The Semiconductor Research Corporation is a highly successful example. The Department of Defense's VHSIC (Very High Speed Integrated Circuits) program, and now its MMIC (Monolithic Microwave Integrated Circuits) program address specific defense needs. SEMATECH (Semiconductor Manufacturing Technology) is a proposed cooperative effort to address the U.S. lag in semiconductor manufacturing technology. A National Laboratory Semiconductor Initiative is being discussed. Other proposals have been made. The problem is that all of these programs and proposals, while good and rational in isolation, are uncoordinated and overlapping when viewed as part of an overall plan to address a national problem.

A coherent strategy that ties the many programs and players together is essential if the nation is to make the best use of the limited resources that are available -- and to succeed.

Our proposal is to form an advisory group patterned after the highly successful work of the National Advisory Committee on Aeronautics in the aviation field. This industry-government cooperative activity has provided the United States with over seven decades of leadership in aviation for both commerce and defense. The National Advisory Committee on Semiconductors would be organized to devise and enunciate the goals of a national semiconductor strategy, the implementation of which could assure the continued leadership of the United States in semiconductor technology. The national semiconductor strategy that will evolve from the Advisory Committee will provide the technological underpinnings for a strong economy and for the national security that are required to achieve the stated goals of the nation.

The Semiconductor Industry Association has attached a high priority to this concept and has assigned to me the lead advocacy role. The recent Report of the Defense Science Board Task Force on Defense Semiconductor Dependency concludes with a similar recommendation that an advisory group be established "to formulate a comprehensive and coherent strategy for legislative, administrative, and management action to reverse the trend toward the export of semiconductor manufacturing and technology leadership."

The Committee's purpose would be to acquire the required information, identify the components of a successful strategy, analyze the options, establish priorities, and recommend roles for participants in the strategy. These results and recommendations would be provided to those bodies of the government involved in legislative, policy-making, administrative, management, planning, and technology activities that affect or are part of a national semiconductor strategy and to the industry and other non-governmental groups or organizations affected by or contributing to the national semiconductor strategy.

In fulfilling this responsibility, the National Advisory Committee on Semiconductors would:

- monitor the competitiveness of the U.S. semiconductor technology base;
- determine technical areas where the U.S. semiconductor technology is deficient relative to international competition;
- identify new or emerging semiconductor technologies that will impact the national defense and/or U.S. competitiveness;
- develop research and development strategies, tactics and plans whose execution will assure U.S. semiconductor competitiveness; and,
- recommend appropriate actions that support the semiconductor strategy.

A response to the leadership challenge through something like the National Advisory Committee on Semiconductors is an essential element in the nation's response.

COOPERATION

Closely coupled to the need to develop leadership is a need for increased cooperation in addressing the problem within the industry and between the industry and government. Rapid growth and intense competition in the semiconductor industry have produced excessive redundancy in the U.S. research and development establishment, a low level of shared generic research activities, and a reduced ability of the industry to compete. It is essential that areas of technology and other activities be identified for which competition among U.S. companies is no longer appropriate and to find means for addressing these cooperatively. Cooperative efforts must address:

(1) increased effectiveness for generic semiconductor research and development in the U.S. such as has been initiated by the Semiconductor Research Corporation;

(2) targets of technological opportunity that will strengthen our competitive position, e.g., joint development of semiconductor manufacturing capability through SEMATECH;

(3) ways to enhance the broad applied generic technology base upon which the industry relies, e.g., integrated circuit (IC) design automation, demonstration facilities for process innovations and new manufacturing techniques, and applied research in IC designs and applications;

(4) the health of the industry infrastructure, i.e., tool makers and materials suppliers;

(5) collective responses to needs for improved acquisition and application of existing knowledge and information that will help the industry; and,

(6) the recapture of consumer product markets in the U.S. in order to provide the semiconductor industry with a strong domestic customer base.

SEMATECH, the initiative now being discussed for addressing the important need for large improvements in the manufacturing capabilities of U.S. semiconductor companies, is an important part of the overall strategy.

FUNDING

Funds must become available to enhance research and development in areas such as manufacturing technology, devices and processes, design and testing, system architectures, applications, materials, fabrication tools, and generic research. In the past, most of these funds have come from industry revenues but, as time has shown, in the competitive environment of the 1980s the industry has not been able to provide funding of the magnitude needed to keep up with the more coordinated and better funded efforts of government-supported foreign competitors. Estimates of the total funding needs have ranged from several hundred million dollars a year to over one billion dollars annually for periods extending to five years and beyond.

The most important immediate need is to implement the government participation in SEMATECH at a level of $100-200 million/year. Additional immediate needs include (1) the implementation of the other recommendations of the Defense Science Board and (2) the proposed National Laboratory Semiconductor Initiative. These proposals, inclusive of SEMATECH, total less than $500 million/year. Even if the National Advisory Committee on Semiconductors should recommend doubling this investment over the next several years, it is a small amount when compared to the significance of the problem.

TECHNOLOGY PLAN

The bottom line for the strategy is a technology plan that results in the availability of the knowledge that enables the industry to compete. A technology plan will include fundamental research, applied research, manufacturing technology, and applications research. For each component of the technology strategy, the level of effort and the performers must be identified. Defense laboratories, the national laboratories, the National Bureau of Standards, and other government entities have a role, as do a variety of independent research organizations, U.S. universities, and the industry itself. In the past, these technology resources have been poorly used. Too many people have been trying to do the same thing with the result that, while much has been accomplished, many technology areas have not and are not being addressed. The whole has been less than the sum of the parts. Through a good technology plan, created under the leadership of the National Advisory Committee, a result can be obtained that is greater than the sum of the parts, i.e., the resources can be used synergically rather than redundantly.

SUMMARY

Our nation's future economic status is firmly wedded to leadership in the high technology industries that depend upon semiconductors. Our national defense is tied to the availability of leading-edge semiconductor devices. The problems we face are of the highest importance; they require national leadership and national solutions if we are to secure our economic competitiveness and our defense preparedness.

Objections to the creation of a monolithic approach to meeting a technology need often arise from the perception that past successes of the United States may be attributed to diversity and internal competition. This was true when the field of competition was within the nation's boundaries. Now, the competition is worldwide, and the rules have changed. Our future depends on our ability to adapt to these new rules.

The logic presented here recommends immediate funding of SEMATECH followed rapidly by funding of several related semiconductor initiatives that have been identified in recent studies of the semiconductor problem of the U.S. At the same time, the National Advisory Committee on Semiconductors should be established to provide the continuing leadership and guidance required to regain clear leadership for the United States in semiconductor technology.

Mr. **Valentine.** Thank you, Mr. Sumney.

The next witness is Mr. Charles H. Ferguson, from the Center for Technology Policy and Industrial Development, Massachusetts Institute of Technology.

Welcome, sir. We are happy to hear from you at this time. As I have said to the other gentlemen, your statement which you filed with the committee will become a part of the record in toto and you may summarize it or proceed in any other way that you deem appropriate, bearing in mind that we have a need to finish this week.

Mr. **Ferguson.** Despite what might perhaps be the prevailing reputation of academics, I will be quite brief.

I was asked to say something about how important the semiconductor industry is and whether there was an appropriate role for the Federal Government in assisting it. The semiconductor industry is about as important as an industry can get. The semiconductor content of all United States manufacturing has gone from zero to two percent in the last 30 years. It is continuing to double approximately every ten years and will continue to do that probably for another 20 years.

The importance of semiconductors is far larger than that number would suggest because semiconductor technology progresses at an absolutely extraordinary rate, so the productivity of these devices and the productivity benefits that they bring to other industries in which the United States wishes to hold, retain, get back, perhaps, leadership is very, very important.

So I don't think there is any doubt that the semiconductor industry deserves saving, and that is what we are talking about. We are talking about saving it. The trend line is that the industry will essentially disappear within the next 5 to 10 years.

The United States industry has lost 20 percent of the world market over the last ten years, and there is no reason to suppose that, absent very drastic actions, that trend would not continue. In fact, I think that it might even accelerate because, in fact, Japanese R&D, not just for current technology but for future technology generations, is now outstripping that of the United States by an extremely wide margin. These are not subtle effects.

Between 1975 and 1982, the United States went from 43 percent to 27 percent of world patenting activity in integrated circuits. Japan went from 18 percent to 48 percent in the same period, and things have gotten worse since 1982, not better.

So there is no doubt that the industry is important. There is no doubt that it has to be saved, I think. The level of effort and knowledge that has been devoted to the industry thus far in the Federal Government and indeed, alas, in the semiconductor industry has not been what we might have hoped. Unfortunately, as other people have said, it does take a crisis for people to begin to think about this in a serious way, but there are many positive signs.

I have been asked to comment on SEMATECH. I think SEMATECH is a very good idea, should be supported very strongly financially and otherwise, if necessary, by the government. I think, however, it is important to recognize that SEMATECH is a necessary but not a sufficient condition. It is a small, interim first step. It is something that will stave off disaster if it works. It is not something that will save the American industry or renew its competitiveness in an enduring way by itself. That will take a much wider effort, as other people have also said.

It will take an effort that encompasses a number of policy domains, and it will take an effort that reaches out to a very long time horizon, to the next 10, 20, 30 years, and it will also take a very great deal of money and will take renewed vigor, shall we say, in the relationship between the Federal Government and the industrial and technological base of this country, a relationship that existed, as other people have pointed out, in the 1950's and 1960's but which no longer exists, and the Defense Department can no longer play the role that it played then.

DOD was the vehicle for these developments in the semiconductor industry and the computer industry and other industries as well during that period. It can no longer be, for two reasons. First of all, it is a very small fraction of total world consumption and production, and second, defense demand now lags commercial technology by a substantial margin, it does not lead it.

That means that we are going to have to think in a very fundamental way about how to create a policy environment that is hospitable to the future development of commercial technology in the United States. SEMATECH is a good idea and I think it is an excellent experiment, but it should be regarded as an interim step in an experiment, I think, an emergency interim step.

I don't mean to minimize its importance. It is extremely important that the semiconductor industry receive attention, but there are other industries, and there is the future to think about, as well.

Thank you.

[The prepared statement of Charles H. Ferguson follows:]

THE DECLINE OF AMERICAN MICROELECTRONICS: ANALYSIS AND IMPLICATIONS

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1. ASSESSMENT OF THE PROBLEM
2. ANALYSIS
3. FUTURE IMPLICATIONS
4. ALTERNATIVE STRATEGIES & POLICIES

SUMMARY: ASSESSMENT OF U.S. MICROELECTRONICS INDUSTRY

1. THE MERCHANT SEMICONDUCTOR INDUSTRY

   LOSING MARKET SHARE TO JAPAN IN ALL PRODUCT CATEGORIES
   PROCESS TECHNOLOGY NOW 2 - 4 YEARS BEHIND JAPAN
   EXTREMELY VULNERABLE FINANCIALLY (1985 LOSSES OF $1B)
   LOW LEVELS OF BOTH R&D AND CAPITAL SPENDING
   INCREASINGLY DEPENDENT UPON JAPANESE TECHNOLOGY (SEE BELOW)
   MANY FIRMS ACTIVELY CONSIDERING BEING ACQUIRED BY JAPANESE FIRMS

2. CAPTIVE PRODUCERS

   IBM IN GENERALLY EXCELLENT CONDITION
   AT&T, DEC, AND HP IN FAIR TO GOOD CONDITION
   ALL OTHERS FAR BEHIND JAPAN IN TECHNOLOGY & SCALE

3. CAPITAL EQUIPMENT & SERVICES

   U.S. LOSING MARKET SHARE IN CRITICAL AREAS
   E BEAM, GLASS, MASKS, TESTERS, STEPPERS
   LIKE MERCHANTS, EQUIPMENT & SERVICES FIRMS FINANCIALLY VULNERABLE
   SEVERELY REDUCED R&D AND CAPITAL SPENDING

4. USERS

   INCREASINGLY DEPENDENT UPON JAPANESE TECHNOLOGY
   FREQUENTLY USING OBSOLETE U.S. TECHNOLOGY (TTL VS. ASICs, ETC.)

RECENT JAPANESE & U.S. SEMICONDUCTOR MARKET SHARES & PERFORMANCE

1. WORLD SEMICONDUCTOR MARKET SHARES (JAPANESE S.O.M., REVENUE)

	N. AMERICA	EUROPE	JAPAN	ROW	WORLD
1982	12	7	87	NA	35
1985	14	12	89	46	41
1986 EST.	~~15~~ 25	~~14~~ 15-20	90	48	~~45~~ 50

SOURCES: 1982 & 1985 BY DATAQUEST; 1986 MY ESTIMATE.

2. WORLD MARKET SHARES BY PRODUCT CLASS (JAPAN S.O.M.)

	MPU	MCU	MOS GATE ARRAYS
1980	10	31	15
1985	41	62	39

...SO THE PROBLEM IS NOT JUST MEMORIES. (SOURCE: DATAQUEST.)

3. COMPARATIVE CAGRs BY PRODUCT / PROCESS CATEGORY

CAGR, 1974 - 1984, SHIPMENTS IN PERCENT

	N. AMERICA	JAPAN
ALL	14	21
ICs	19	31
MOS IC	24	38
CMOS IC	32	63

SOURCE: DATAQUEST.

4. BILATERAL TRADE BALANCE, U.S. - JAPAN

1983	- 354 M
1984	- 917 M
1985	- ~~750~~ 500 M (EST.)
1986	- 1 B (EST.)

CAPITAL EQUIPMENT & SERVICES MARKETS

1. MASK MAKING & GLASS
   HOYA (AND SHIN-ETSU NOW DOMINATE WORLD GLASS SUPPLIES (FORMERLY CORNING)
   JAPAN ENTERED MASK MARKET 2 YEARS AGO
   3 MAJOR JAPANESE FIRMS (INCL. HOYA), 2 WITH REVENUES OVER 50M
   15 U.S. FIRMS, LARGEST IS 16M, MOST LOSING MONEY
   EFFICIENT SCALE NOW REQUIRES 25M INVESTMENT

2. E BEAM SYSTEMS FOR MASK MAKING & DIRECT WRITING
   5 U.S. FIRMS HAVE DROPPED OUT, WRITING OFF $100M
   ONLY MAJOR U.S. FIRMS REMAINING ARE PERKIN ELMER, IBM, HP?
   3 JAPANESE FIRMS, 1 ALREADY MARKETING IN U.S. (JEOL)

3. STEPPERS + LITHOGRAPHY EQUIPMENT
   CANON & NIKON GAINING MARKET SHARE WITH 5X, 10X SYSTEMS
   GCA NEAR BANKRUPTCY ($100M LOSS IN 85)
   ASIDE FROM PERKIN ELMER, OTHER 10X SUPPLIERS FINANCIALLY WEAK

4. TESTERS
   TAKEDA, ANDO GAINING MARKET SHARE
   GENRAD IN SERIOUS TROUBLE
   TERADYNE HOLDING BUT FACING STRONG COMPETITION
   OTHER U.S. FIRMS FINANCIALLY WEAK
   TAKEDA REPORTEDLY SUPERIOR IN RELIABILITY

U.S. MERCHANTS & CAPTIVES INCREASINGLY DEPENDENT UPON JAPANESE MASKS, GLASS, AND CAPITAL EQUIPMENT.

EVOLUTION OF THE U.S. SEMICONDUCTOR INDUSTRY (MERCHANT / CAPTIVE)

AT&T INVENTS TRANSISTOR IN 1947; DOJ SUES AT&T IN 1949; AT&T SETTLES IN 1956; INTEGRATED CIRCUITS INVENTED IN 1960-61.

MERCHANT INDUSTRY ESTABLISHED DURING 1960s, FACILITATED BY:
- AT&T LICENSING (DOJ PRESSURE, 1956 SETTLEMENT)
- LOW-INITIAL-COST, LABOR INTENSIVE TECHNOLOGY IN EARLY 1960s
- DOD COST-PLUS PURCHASES AND SECOND-SOURCING REQUIREMENTS
- VENTURE CAPITAL AVAILABILITY AND EARLY STARTUPS IN CALIFORNIA
- IBM STAYS CAPTIVE ONLY (STRATEGY, 1969 ANTITRUST SUIT)
- EXTENSIVE INFRASTRUCTURE DEVELOPS TO SERVICE SMALL FIRMS
- EUROPEAN & JAPANESE INFERIORITY PERMITS INTERNAL U.S. DYNAMICS TO DOMINATE INDUSTRY EVOLUTION
- INDUSTRY INSTABILITY RESTRICTS CONSUMERS TO CUSTOM CAPTIVE PRODUCTION

RESULT: U.S. MERCHANT INDUSTRY DOMINATES WORLD SEMICONDUCTOR PRODUCTION - EXCEPT JAPAN, WHICH PROTECTS ITS MARKET.

- 2:1 RATIO OF MERCHANT TO CAPTIVE PRODUCTION
- MERCHANTS PRODUCE GENERAL PURPOSE CIRCUITS
- CAPTIVES PRODUCE CUSTOM & SPECIALIZED CIRCUITS
- U.S. MERCHANTS HOLD 95% OF U.S., 60% OF EUROPEAN, AND 20% OF JAPANESE MARKET
- PRODUCT CYCLE OF DOD PURCHASES, U.S. COMMERCIALIZATION, THEN PRODUCTION & MARKETING OF MATURE PRODUCTS ELSEWHERE
- DOD ROLE GRADUALLY DECLINES AS COMMERCIAL MARKETS GROW

BUT - A STRUCTURE WITH SEVERE LONG-TERM WEAKNESSES, EVENTUALLY FATAL.

1965 - 1982
STRUCTURE & DYNAMICS OF THE CLASSICAL MERCHANT INDUSTRY

EXTREME ENTREPRENEURIALISM: THE INDUSTRY IS DOMINATED BY NETWORKS OF SMALL, UNSTABLE FIRMS; VENTURE-CAPITAL FUNDING PRODUCES CONTINUOUS STREAM OF STARTUPS FOUNDED BY DEFECTORS FROM EXISTING FIRMS; HIGH LEVELS OF ENTRY & EXIT.

SOME CHARACTERISTICS OF THE INDUSTRY:

- TRANSITORY MARKET SUCCESS, SHORT PRODUCT GENERATIONS, AND UNSTABLE INDUSTRY LEADERSHIP
- CHARACTERISTIC FIRM LIFE CYCLES & GENERATIONAL CRISES
- HIGH TURNOVER RATES (20% INDUSTRYWIDE, HIGHER IN STARTUPS)
- EXTREME VERTICAL, HORIZONTAL, AND FUNCTIONAL FRAGMENTATION
- SHORT TIME HORIZONS
- PREFERENCE FOR LOW INITIAL COST, LABOR INTENSIVE TECHNOLOGY: LEASING, SUBCONTRACTORS, OFFSHORE ASSEMBLY
- RAPID TECHNOLOGY DIFFUSION WITHIN U.S. FROM TURNOVER, DEFECTIONS TO FORM STARTUPS, IMITATION, LICENSING

SOME CONSEQUENCES:

- LITTLE STRATEGIC OR LONG RANGE PLANNING; LITTLE LONG-RANGE COOPERATION; NO PROVISION OF COLLECTIVE GOODS
- DOMINATION OF INNOVATION BY SMALL, YOUNG FIRMS (STARTUPS)
- PAROCHIAL, INEXPERIENCED, AND/OR UNSOPHISTICATED MANAGEMENT
- ABSENCE OF ENDURING, PROPRIETARY, COMPETITIVE ADVANTAGE
- LITTLE EXPERIENCE WITH SYSTEMS TECHNOLOGIES OR CUSTOM DESIGN
- HIGH EXPOSURE TO EXTERNAL TECHNOLOGY EXTRACTION AND/OR ENTRY
- INABILITY TO DEVELOP OR EXPLOIT CAPITAL INTENSIVE TECHNOLOGY

1955	Shockley Transistor,[b] Clevite,[b] ITT[b]
1956	
1957	Fairchild Semiconductor[a]
1958	
1959	National Semiconductor, Rheem Semiconductor[b,c]
1960	
1961	Signetics,[c] Amelco,[c] Raytheon Semiconductor, H.P. Associates
1962	Siliconix,[c] Molectro[b,c]
1963	Stewart Warner Microcircuits,[b] General Microelectronics[b,c]
1964	Union Carbide Electronics[b]
1965	
1966	Philco-Ford Microelectronics,[b] American Micro-Systems, Cal-Dak[b]
1967	National Semiconductor,[c,d] Electronic Arrays,[b] Intersil[b]
1968	Cermetek,[c] Monsanto Electronics, Avantek, Lab-Go, Integrated Systems Technology, Nortec, Kinetic Technology,[b] Intel,[c] Computer Micro-Technology,[b,c] Qualidyne,[b,c] Electro Nuclear Labs, Advanced Memory Systems,[b,c] Precision Monolithics,[c]
1969	Lithic Systems,[b] Communications Transistor Corp., Monolithic Memories, Cartesian,[c] Advanced LSI Systems,[b] Signetics Memory Systems, Advanced Micro Devices,[c] Four Phase
1970	Litronix,[b] Integrated Electronics,[c] Varadyne,[b] International Computer Modules[b]
1971	Cal-Tex,[b] Exar, Micro Power, Intersil Memory, Standard Microsystems,[b] Antex[b]
1972	LSI Systems,[b] Nitron,[b] Frontier Electronics,[b] Interdesign,[b] Light Emitting Devices,[b] IC Transducers,[b,c] Opto Ray,[b,c] Optical Diodes,[b]
1973	Data General,[c] Synertek[b,c]
1974	Monosil, Zilog
1975	Mnemonics,[b] Maruman Integrated Circuits, Exonix, Semi Processes[b]
1976	Supertex,[c] Cognition,[c] Integrated Technology Corp.[c]

Source: Revolution In Miniature, p. 127, from Don Hoefler, SEMI. Note: Data not complete. Some firms, e.g. Four Phase, were not merchants.

Selected ASIC Startups, 1980 - 1983

1980	Applied Micro Circuits, LSI Logic Corp., VLSI Technology, Silicon Systems
1981	International Microcircuits, International Microelectronics Products, Telmos, Zytrex
1982	Array Devices, Array Technology, Custom MOS Arrays, Cypress Semiconductor, Lattice Logic
1983	Altera Semiconductor, Exel Microelectronics, International CMOS Technology, Lattice Semiconductor, SMOS Systems, Wafer Scale Integration

Source: Dataquest Corp., 1984. Note: list incomplete, even for Application Specific Integrated Circuit (ASIC) firms. Non-ASIC startups in this period included Gigabit Logic, Linear Technology Corp., and Seeq, among others.

	Valves*	Transistors (1955)	Semiconductors (1960)	Semiconductors (1965)	Integrated circuits (1975)	Integrated circuits (1979)
RCA	1	7	5	6	8	9
Sylvania	2	4	10			
General Electric	3	6	4	5		
Raytheon	4			10		
Westinghouse	5	8				
Amperex	6					
National Video	7					
Rauland	8					
Eimac	9					
Lansdale Tube	10					
Hughes		1	9			
Transitron		2	2	9		
Philco		3	3	8		
Texas Instruments		5	1	1	1	1
Motorola		9	6	2	5	3
Clevite		10	7			
Fairchild			8	3	2	5
General Instrument				4	7	10
Sprague				7		
National Semiconductor					3	2
Intel					4	4
Rockwell					6	
Signetics					9	6
American Microsystems					10	
Mostek						7
American Micro Devices						8

Source: I. M. Mackintosh, 'Large-scale integration: intercontinental aspects', *IEEE Spectrum*, 15, 6 (June 1976) 54; *Dataquest* (29 February 1980).

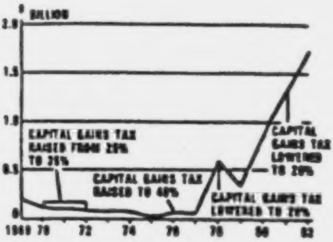
U.S. - Based Semiconductor Producers Ranked by World Market Share
Source: As above, cited in Revolution in Miniature, p. 123.
Note: Advanced Micro Devices (AMD) is incorrectly identified as American Micro Devices.

Worldwide Semiconductor Producers Ranked by World Market Share, 1974 and 1983

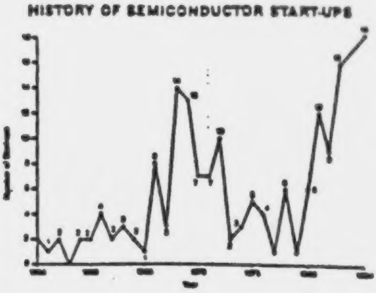
Firm	1974	1983
Texas Instruments	1	1
Fairchild	2	-
National	3	5
Motorola	4	3
Signetics	5	7
Intel	6	6
RCA	7	-
NEC	8	2
AMI	9	-
Hitachi	10	4
Fujitsu	-	8
Toshiba	-	9
AMD	-	10

Source: Dataquest Corp., 1984.

New Private Capital Committed to Independent Ventures

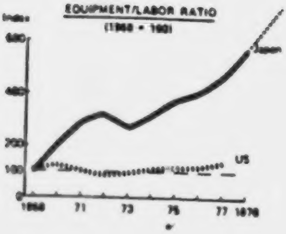


Source: Venture Economics, reprinted in J. Fred Bucy, "Computer Sector Profile," in National Academy of Sciences, Technological Frontiers and Foreign Relations, 1985, p. 72.



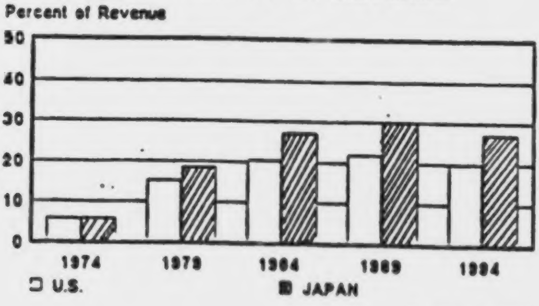
Estimated Semiconductor Startups, 1965 - 1984, U.S. Only.
Source: Dataquest Corp., 1984.

RELATIVE JAPANESE / AMERICAN CAPITAL INTENSITY



SOURCE:
McKINSEY + CO.

ESTIMATED CAPITAL EXPENDITURES AS A PERCENT OF REVENUE



Source: DATAQUEST

VLSI AND THE DESTRUCTION OF THE MERCHANT REGIME, 1975 - 1990

DIRECT IMPLICATIONS OF VLSI:

1. CIRCUITS BECOME SYSTEMS. SYSTEM DESIGN AND CIRCUIT TECHNOLOGY BECOME INTERDEPENDENT, DESTABILIZING MERCHANT - CONSUMER RELATIONSHIPS.
2. VLSI PROCESSING REQUIRES MULTIPLE, INTERDEPENDENT, SYSTEMS-INTENSIVE TECHNOLOGIES:
   CAD/CAE; CAM/CIM; ATE; OTHER CAPITAL EQUIPMENT; SOFTWARE & DEVELOPMENT SYSTEMS; PLUS CONVENTIONAL PROCESS TECHNOLOGIES (DIFFUSION OVENS, ETC.)
3. MINIMUM EFFICIENT SCALE & CAPITAL REQUIREMENTS INCREASE TENFOLD IN LESS THAN TEN YEARS.
   FAB COST, $20M IN 1978, NOW $200M AND GROWING
   VLSI DEVICE DESIGN COSTS CAN EXCEED $50M
   CAPITAL EQUIPMENT DEVELOPMENT COSTS AVERAGE $30M
   MASK FAB, FORMERLY $0.5M, NOW $20M

MARKET EFFECTS:

1. MARKETS WIDEN AS EVERYTHING CAN BE DIGITIZED EFFICIENTLY.
2. MICROELECTRONICS BECOMES A CRITICAL STRATEGIC TECHNOLOGY TO SYSTEMS, TELECOM, AUTO, DEFENSE, & OTHER SECTORS.
3. DOWNSTREAM INDUSTRIES ARE DESTABILIZED; E.G. SYSTEMS AND TELECOMMUNICATIONS MERGE; CONSUMER ELECTRONICS BECOMES DIGITAL HIGH TECHNOLOGY; FACTORIES BECOME SYSTEMS.

STRATEGIC RESULT: VLSI FORCED JAPAN TO ENTER MICROELECTRONICS AT THE SAME TIME AS IT MADE THE MERCHANT REGIME OBSOLETE.

THE LOGIC OF JAPANESE PENETRATION

SUMMARY: CAPITAL-INTENSIVE PHASED ENTRY BY OLIGOPOLISTICALLY COORDINATED, VERTICALLY INTEGRATED INDUSTRIAL COMPLEXES.

CHARACTERISTICS AND PHASES OF JAPANESE PENETRATION:

1. TECHNOLOGY EXTRACTION FROM MERCHANT INDUSTRY - LICENSING, PURCHASES, IMITATION, REVERSE ENGINEERING, SOME THEFT.
2. GOVERNMENT-SUPPORTED, PARTIALLY REGULATED, COORDINATED R&D.
3. LONG-RANGE, EXTREMELY HIGH QUALITY STRATEGIC PLANNING.
4. PHASED AND COORDINATED MARKET ENTRY: BEGINNING WITH PURE COMMODITIES (DRAMs), PROGRESSING TO PROPRIETARY LOGIC. CHARACTERISTIC CYCLE:
    - LICENSE TECHNOLOGY, INVEST HEAVILY.
    - ENTER A LARGE COMMODITY MARKET WHILE CLOSING THE DOMESTIC MARKET.
    - IN LOGIC, PROGRESS FROM LICENSING TO REVERSE ENGINEERING TO PROPRIETARY DESIGN.
5. USE EXTREMELY CAPITAL INTENSIVE, HIGHLY AUTOMATED TECHNOLOGY.
6. GOVERNMENT PROVIDES AND/OR ENSURES COLLECTIVE GOODS: R&D FUNDS, PRICE CONTROL, EDUCATION, POLITICAL RISK ANALYSIS & MANAGEMENT, MARKET CLOSURE, ETC.
7. FIRMS SUPPLY THEMSELVES, EACH OTHER WITHIN JAPAN, AND COMPETE PRIMARILY FOR EXPORT MARKETS.
8. COORDINATED, PROGRESSIVE IMPORT SUBSTITUTION AND EXPORT PENETRATION IN CAPITAL EQUIPMENT & SERVICES MARKETS. SYSTEMATIC USE OF U.S. FIRMS' WILLINGNESS TO DESTROY EACH OTHER

640

STRATEGIC RISK IN THE SYSTEMS INDUSTRY:
SEMICONDUCTOR TECHNOLOGY AND SOURCING DEPENDENCE BY DEVICE CLASS

RAMs

IBM & AT&T PRODUCE COMPETITIVE PRODUCTS INTERNALLY.

ALL OTHER FIRMS DEPEND UPON JAPANESE SOURCES.

MPUs

AT&T, HP, DEC, AND DG PRODUCE PROPRIETARY 32 BIT MPUs.

IBM HAS EXCELLENT TECHNOLOGY, PLUS 20% OF INTEL.

ALL OTHERS DEPEND UPON OPEN-MARKET MPUs.

ROMs

ALL FIRMS, INCLUDING IBM, SIGNIFICANTLY DEPENDENT UPON THE MARKET.

ASICs (GATE ARRAYS, ETC.)

IBM HAS WORLD CLASS TECHNOLOGY.

AT&T HAS COMPETITIVE TECHNOLOGY.

HP & DEC HAVE SOME TECHNOLOGY.

ALL OTHERS HAVE POOR TECHNOLOGY OR DEPEND UPON THE OPEN MARKET.

LSI/VLSI [redacted] LOGIC

IBM, AT&T, HP, AND DEC HAVE COMPETITIVE TECHNOLOGY.

ALL OTHERS DEPEND UPON OPEN MARKET SOURCES.

GENERAL ASSESSMENT: IBM - EXCELLENT; AT&T - GOOD; DEC & HP - FAIR; ALL OTHERS - VERY POOR.

FOR SEMICONDUCTOR CAPITAL EQUIPMENT, DEPENDENCE IS FAR GREATER.

STRATEGIC RISK IN THE SYSTEMS INDUSTRY:
SUBSYSTEM & SYSTEM SOURCING FROM JAPAN

SPERRY: MAINFRAME TECHNOLOGY FROM HITACHI
PC COMPATIBLES FROM MITSUBISHI

AMDAHL: MAINFRAME TECHNOLOGY & SUPERCOMPUTERS FROM FUJITSU

NAS: MAINFRAMES & SUPERCOMPUTERS FROM HITACHI

HONEYWELL: ACOS MAINFRAMES FROM NEC; POSSIBLY DASD ALSO.

BURROUGHS: SOLID STATE DISKS FROM HITACHI
FACSIMILE EQUIPMENT FROM SEVERAL FIRMS
DASD FROM SEVERAL FIRMS

MANY FIRMS (APPLE, HP, IMAGEN, ETC.) USE CANON'S LASER PRINTER.
MANY FIRMS ALSO SOURCE PC COMPATIBLES FROM JAPAN.
ALMOST ALL FIRMS SOURCE MOST INTERNALLY USED ROBOTS FROM JAPAN.
ALMOST ALL FIRMS SOURCE FLOPPY DISK DRIVES FROM JAPAN.
MANY FIRMS SOURCE DISPLAYS FROM JAPAN OR TAIWAN.

SOME CONCLUSIONS & PREDICTIONS

1. MOST U.S. MERCHANT FIRMS WILL FAIL OR BECOME JAPANESE WITHIN FIVE YEARS IF PRESENT TRENDS CONTINUE.
2. U.S. MERCHANT FIRMS NOW INFERIOR TO JAPAN IN:
    - MANAGEMENT & PLANNING
    - PROCESS TECHNOLOGY & MANUFACTURING
    - FINANCE
    - SOPHISTICATION IN MULTINATIONAL & GOVERNMENT ARENAS

   REMAINING STRENGTHS: CAD, DESIGN, SOFTWARE; BUT ERODING HERE TOO.
3. RESTORING U.S. COMPETITIVENESS WILL REQUIRE ENORMOUS RESOURCE COMMITMENTS - BILLIONS OF DOLLARS.
4. CONTINUED U.S. DECLINE WOULD SOON RESULT IN JAPANESE PENETRATION OF SYSTEMS, TELECOMMUNICATIONS, AND AEROSPACE.
5. MONEY ALONE WILL NOT SOLVE THE PROBLEM. POLICY & INDUSTRY STRUCTURE MUST BE CHANGED.
6. DEFENSE NEEDS WILL CONTINUE TO REQUIRE A COMPETITIVE COMMERCIAL INDUSTRY - TOO MUCH IS DUAL USE.

SOME TENTATIVE RECOMMENDATIONS

1. SEVERAL CONVENTIONAL STRATEGIES SHOULD BE AVOIDED: CURRENT PROTECTIONIST EFFORTS - DRAM ANTIDUMPING CASE, ETC.
    - A) LITTLE HELP TO U.S. PRODUCERS WHO HAVE ALREADY EXITED THE DRAM BUSINESS.
    - B) PENALIZES U.S. FIRMS WITH JAPANESE PLANTS
    - C) PENALIZES U.S. CONSUMERS IN CRITICAL AREAS. RAISING THE COST OF U.S. COMPUTERS DOES NOT SOLVE THE PROBLEM.
2. SUPPORT FOR VENTURE CAPITAL & INDEPENDENT ENTREPRENEURS WOULD HURT NOT HELP.
3. SIMILARLY, UNRESTRICTED R&D FUNDING WILL NOT HELP.
    - A) SUPPORT FOR FURTHER FRAGMENTATION
    - B) JAPANESE ACCESS TO U.S. WORK.

SOME POSSIBLE ALTERNATIVES:

1. LARGE, TARGETED RESOURCE COMMITMENTS: EDUCATION; NATIONAL LABS; LARGE U.S. FIRMS.
2. STABILIZE & RATIONALIZE THE INDUSTRY
    - A) SUPPORT CONCENTRATION & VERTICAL INTEGRATION
    - B) FAVOR VENTURE INVESTMENT BY LARGE, ESTABLISHED FIRMS
    - C) COUNTERCYCLICAL GOVERNMENT PURCHASING (?)
3. CHANGE INCENTIVES
    - A) GET SERIOUS WITH JAPAN: CREDIBLE (DOWNSTREAM) PROTECTIONISM; PROSECUTIONS; MARKET ACCESS.
    - B) NEUTRALIZE ANY REMAINING ANTITRUST PROBLEMS
    - C) FAVOR LONGER TIME HORIZONS IN PLANNING & SPENDING

EVOLUTION OF JAPANESE PENETRATION 1979 - 1985

WORLD SEMICONDUCTOR MARKETS

JAPANESE MEMORY WORLD MARKET SHARE, %

MOS DYNAMIC RAM'S (CURRENT GENERATION)

YEAR	LEVEL	MARKET SHARE
1970	1 K	zero
1974	4 K	5
1978	16 K	40
1982	64 K	70
1985	256 K	85
1987	1 M	90+ (EST.)

JAPAN ALSO DOMINATES CMOS STATIC RAM MARKETS.

SOURCES: DATAQUEST; HAMBRECHT + QUIST; SIA.

Estimated Market Share by Region for all Microprocessors from 1980 to 1983
(Thousands of Units)

		1980	1981	1982	1983
EUROPE	UNITS SHIPPED	456	948	1506	3723
	PERCENTAGE SHIPPED	1.95%	2.65%	2.88%	4.96%
JAPAN	UNITS SHIPPED	2375	5772	11415	19979
	PERCENTAGE SHIPPED	10.15%	16.15%	21.88%	26.61%
UNITED STATES	UNITS SHIPPED	20562	29019	39256	51367
	PERCENTAGE SHIPPED	87.90%	81.20%	75.24%	68.43%
TOTAL	UNITS SHIPPED	23393	35739	52177	75069
	PERCENTAGE SHIPPED	100.00%	100.00%	100.00%	100.00%

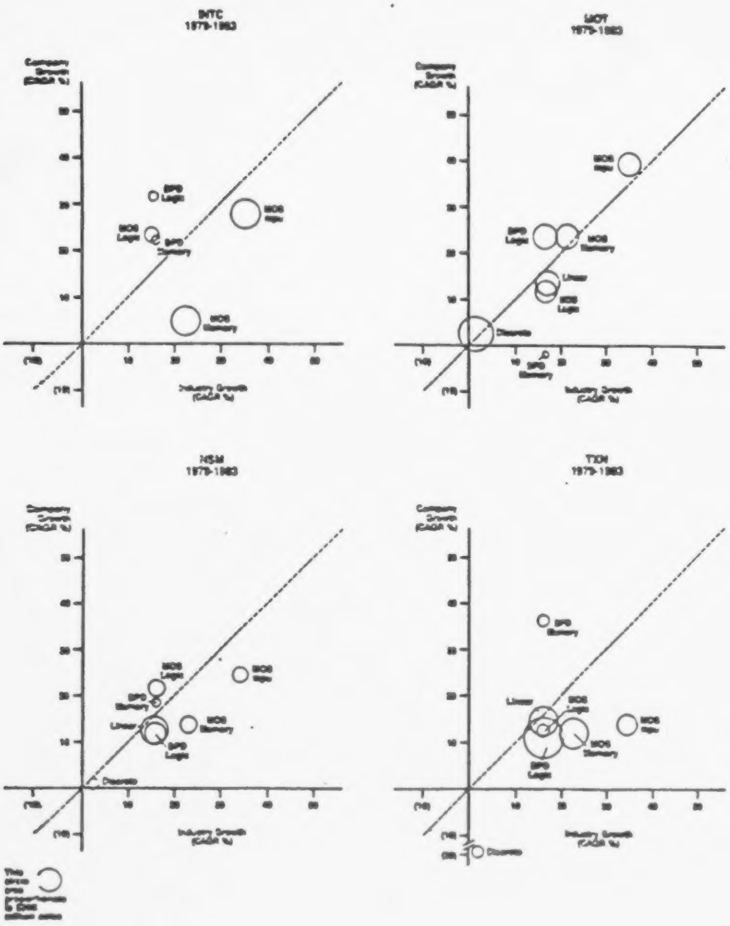
Source: DATAQUEST
August 1984

Estimated Market Share by Region for all Microcontrollers from 1980 to 1983
(Thousands of Units)

		1980	1981	1982	1983
EUROPE	UNITS SHIPPED	134	1475	4517	8978
	% OF TOTAL SHIPMENTS	0.11%	0.88%	2.13%	3.42%
JAPAN	UNITS SHIPPED	36790	86524	128129	164560
	% OF TOTAL SHIPMENTS	31.22%	51.34%	60.34%	62.65%
UNITED STATES	UNITS SHIPPED	80904	80517	79701	89111
	% OF TOTAL SHIPMENTS	68.67%	47.78%	37.53%	33.93%
TOTAL	UNITS SHIPPED	117828	168516	212347	262649
	% OF TOTAL SHIPMENTS	100.00%	100.00%	100.00%	100.00%

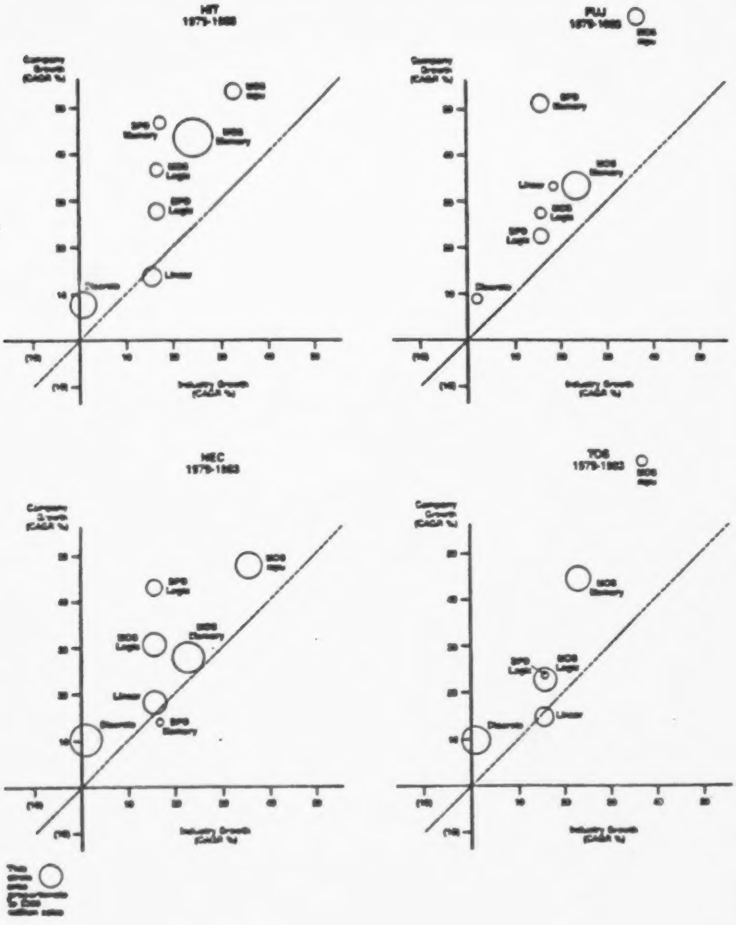
Source: DATAQUEST
August 1984

U.S. Semiconductor Companies: Growth By Product Line, 1979-1983



COURTESY M. SUZANNE PETERSON
1ST BOSTON

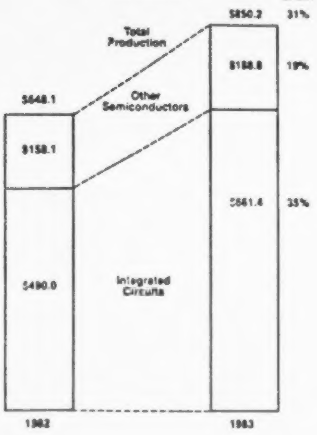
Japanese Semiconductor Companies: Growth By Product Line, 1979-1983



COURTESY M. SUZANNE PETERSON
1ST BOSTON

AND SOON, KOREA TOO

Korean Semiconductor Production
($US Millions)



COURTESY
M SUZANNE PETERSON
1ST BOSTON

VERY SIMILAR TO JAPAN:

- 4 LARGE INDUSTRIAL GROUPS
- HIGH LEVELS OF INVESTMENT
- LICENSED TECHNOLOGY, FOLLOWED BY INDEPENDENT EFFORT
- EFFICIENT MASS PRODUCTION

Table 1

PRELIMINARY 1985 WORLD SEMICONDUCTOR MARKET SHARE RANKING
(Millions of Dollars)

85 Domestic	1985 Rank	1984 Rank	Company	1984	1985	Percent Change
	1	3	NEC	2251	1984	-11.9%
1	2	2	Motorola	2320	1850	-20.3%
2	3	1	Texas Instruments	2480	1766	-28.8%
	4	4	Hitachi	2052	1671	-18.6%
	5	5	Toshiba	1561	1459	-6.5%
	6	6	Philips/Signetics	1325	1068	-19.4%
	7	9	Fujitsu	1190	1020	-14.3%
3	8	8	Intel	1201	1020	-15.1%
4	9	7	National	1263	940	-25.6%
	10	12	Matsushita	928	906	-2.4%
	11	10	Mitsubishi	964	706	-26.8%
5	12	11	AMD	936	603	-35.6%
6	13	13	Fairchild	665	494	-25.7%
	14	15	Sanyo	455	457	0.4%
	15	16	Siemens	450	420	-6.7%
	16	20	Sharp	354	329	-7.1%
7	17	17	RCA	402	325	-19.2%
	18	22	Thomson	301	324	7.6%
	19	19	Oki	362	307	-15.2%
	20	21	SGS-Ates	335	300	-10.4%
	21	18	General Instrument	362	280	-22.7%
	22	25	ITT	250	270	8.0%
	23	23	Harris	275	265	-3.6%
	24	24	Rohm	252	250	-0.8%
	25	26	Analog Devices	210	206	-1.9%
	26	27	MMI	200	200	0.0%
	27	30	Fuji Electric	176	173	-1.7%
	28	33	Telefunken	161	170	5.6%
	29	29	Sony	177	168	-5.1%
	30	28	Hewlett-Packard	182	155	-14.8%
	31	32	Sanken Electric	162	149	-8.0%
	32	31	AMI	164	140	-14.6%
	33	38	IR	115	128	11.3%
	34	47	LSI Logic	84	125	48.8%
	35	14	Mostek	467	125	-73.2%
	36	35	TRW	142	120	-15.5%
	37	36	General Electric	136	114	-16.2%
	38	42	Siliconix	97	114	17.5%
	39	40	Unitrode	106	104	-1.9%
	40	49	Plessey	82	99	20.7%
	41	41	Ferranti	105	98	-6.7%
	42	57	Samsung	60	95	58.3%
	43	39	Seiko Epson	115	93	-19.1%
	44	46	NCR	85	90	5.9%
	45	48	Sprague	84	87	3.6%
	46	34	Inmos	146	85	-41.8%
	47	44	Intersil	89	80	-10.1%
	48	43	Raytheon	95	80	-15.8%
	49	55	Honeywell	64	79	23.4%
	50	53	VLSI Technology	69	78	13.0%
			Top 50 total	26507	22169	-16.4%

Source: DATAQUEST
January 1986

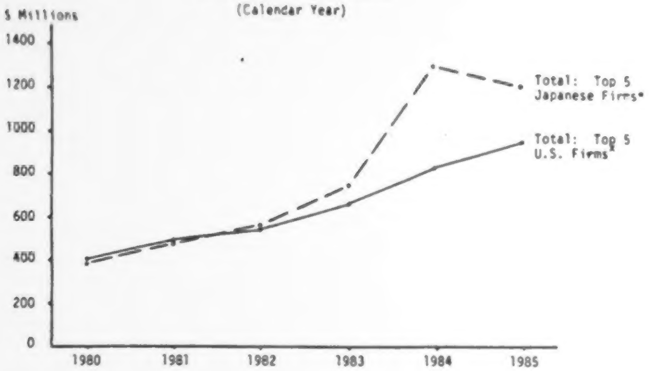
Table 4

PRELIMINARY 1985 WORLD MOS MARKET SHARE RANKING
(Millions of Dollars)

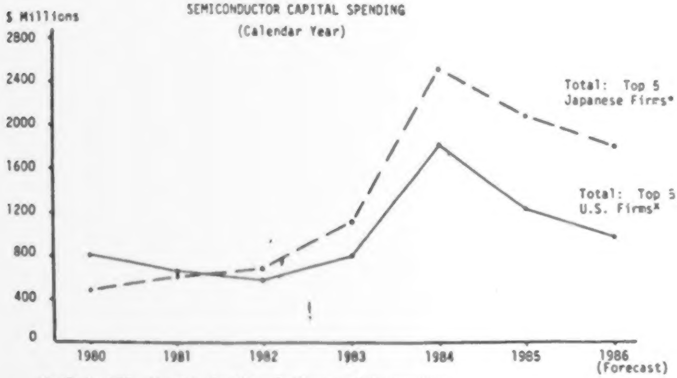
1985 Rank	1984 Rank	Company	1984	1985	Percent Change
1	1	NEC	1414	1174	-17.0%
2	3	Intel	1166	998	-14.4%
3	2	Hitachi	1167	853	-26.9%
4	6	Toshiba	770	727	-5.6%
5	4	Motorola	967	685	-29.2%
6	7	Fujitsu	753	631	-16.2%
7	5	Texas Instruments	917	524	-42.9%
8	8	Mitsubishi	541	320	-40.9%
9	11	National	430	301	-30.0%
10	9	AMD	480	299	-37.7%
11	13	Matsushita	283	269	-4.9%
12	12	Oki	315	264	-16.2%
13	14	Philips/Signetics	266	228	-14.3%
14	15	Sharp	214	173	-19.2%
15	16	RCA	210	165	-21.4%
16	17	AMI	164	140	-14.6%
17	28	LSI Logic	83	125	50.6%
18	10	Mostek	467	115	-75.4%
19	19	General Instrument	132	111	-15.9%
20	23	Harris	105	111	5.7%
21	25	Thomson	93	107	15.1%
22	22	Seiko Epson	115	93	-19.1%
23	20	Siemens	126	92	-27.0%
24	29	ITT	80	90	12.5%
25	27	NCR	85	90	5.9%
26	24	SGS-Ates	102	88	-13.7%
27	18	Inmos	146	85	-41.8%
28	31	VLSI Technology	69	78	13.0%
29	33	Sanyo	67	68	1.5%
30	26	Zilog	88	59	-33.0%
31	30	Standard Micro.	70	56	-20.0%
32	32	Western Digital	68	56	-17.6%
33	48	Samsung	25	55	120.0%
34	36	Sony	51	49	-3.9%
35	21	Micron Technology	120	46	-61.7%
36	34	Rockwell	57	44	-22.8%
37	41	IDT	34	41	20.6%
38	43	Hughes	32	36	12.5%
39	42	Matra-Harris	33	36	9.1%
40	47	Plessey	26	35	34.6%
41	35	SEEQ	53	34	-35.8%
42	46	UMC	27	33	22.2%
43	39	Xicor	39	33	-15.4%
44	38	SSSI	40	30	-25.0%
45	45	IMP	28	27	-3.6%
46	44	ERSO	30	25	-16.7%
47	37	Fairchild	45	22	-51.1%
48	51	Eurosil	20	21	5.0%
49	52	MEDL	16	20	25.0%
50	54	Micropower Systems	15	20	33.3%
		Top 50 total	12644	9782	-22.6%

Source: DATAQUEST
January 1986

SEMICONDUCTOR R&D SPENDING
(Calendar Year)



SEMICONDUCTOR CAPITAL SPENDING
(Calendar Year)

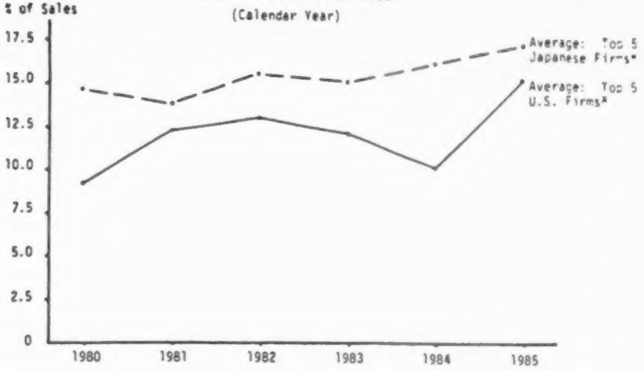


*Includes NEC, Hitachi, Toshiba, Fujitsu, and Matsushita

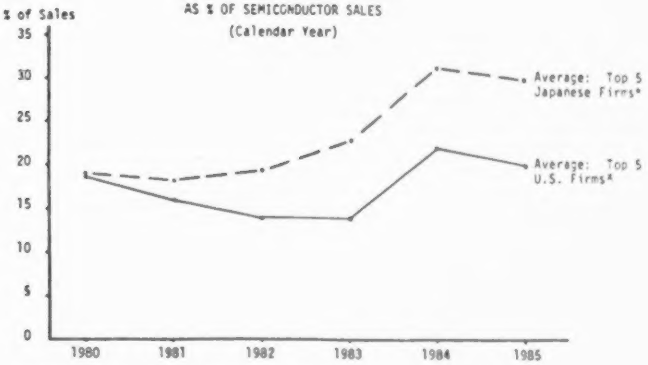
^xIncludes TI, Motorola, Intel, National, and AMD

Based on Dataquest Numbers

SEMICONDUCTOR R&D
AS % OF SEMICONDUCTOR SALES
(Calendar Year)



SEMICONDUCTOR CAPITAL SPENDING
AS % OF SEMICONDUCTOR SALES
(Calendar Year)



*Weighted Average of NEC, Hitachi, Toshiba, Fujitsu, and Matsushita

^xWeighted Average of TI, Motorola, Intel, National, and AMD

Based on Dataquest Numbers

Calendar Year
Semiconductor Capital Spending and R and D
(Millions of Dollars)

Company	1980		1981		1982		1983	
	Capital	R&D	Capital	R&D	Capital	R&D	Capital	R&D
U.S.								
T.I.	300	102	145	119	140	128	232	163
Motorola	177	92	184	116	160	128	176	155
Intel	156	89	157	109	138	122	146	132
National	116	79	105	94	82	107	120	113
AMD	49	36	58	48	67	59	111	91
European								
Philips-Signetics	115	50	117	44	120	27	115	69
Siemens	51	22	60	18	75	11	87	33
Thomson	27	12	34	10	37	6	30	17
SGS	25	8	23	8	35	5	31	15
Telefunken	21	9	19	7	21	5	28	10
Japanese								
NEC	136	131	170	157	192	187	231	239
Hitachi	97	91	144	111	164	136	249	189
Toshiba	55	75	85	86	128	90	345	120
Fujitsu	114	52	140	67	160	90	213	128
Matsushita	93	36	85	51	40	51	85	69

	1984		1985		1986*	
	Capital	R&D	Capital	R&D	Capital	R&D
U.S.						
T.I.	472	195	275	214	260	
Motorola	412	176	325	192	250	
Intel	388	163	215	175	180	
National	300	141	242	182	145	
AMD	237	145	182	182	143	
European						
Philips-Signetics	143	92				
Siemens	113	42				
Thomson	51	23				
SGS	62	21				
Telefunken	23	11				
Japanese[x]						
NEC	549	399	520	349	500	
Hitachi	510	321	390	259	318	
Toshiba	580	203	520	188	417	
Fujitsu	490	236	303	201	287	
Matsushita	372	114	368	111	287	

*Forecast

Source: Dataquest
April 29, 1986

[x] Japanese 1985 R&D numbers are being revised upward per telephone conversation May 28, 1986.

Mr. Valentine. Thank you very much, sir.

We wanted our colleague, Mr. Mineta, to have an opportunity to introduce the next witness, so I think we will just hold your testimony and question these other two gentlemen while we wait for Mr. Mineta to come in.

I would like to ask this question to you, Mr. Ferguson. This has reference to legislation that I referred to earlier that I am personally interested in, H.R. 2191. I am not interested in it as any kind of show vehicle or any kind of statement other than an effort to get something started in this area that will help to reverse the very gloomy predictions that have been made by many witnesses.

Are you familiar with the effort to create a National Advisory Committee on Semiconductors, and what do you think about that?

Mr. Ferguson. I have heard a few discussions. I think it is an extremely good idea. I think that anything that effectively increases the level of attention paid to this industry and increases the amount of discussion at a high level about this industry is an excellent idea.

Mr. Valentine. Thank you, sir.

I see that our colleague, Mr. Mineta, has come onto the scene, and we will recognize him at this time.

Mr. Mineta. Thank you very much, Mr. Chairman.

At this time I would like to take the opportunity to introduce a very good friend and a leader in the semiconductor industry, Mr. Charlie Sporck, who is the Chairman and Chief Executive Officer of National Semiconductor. Charlie is also a board member and founding member of the Semiconductor Industry Association, the SIA. When I first got back here and used the acronym "SIA," I assumed everyone knew what I was talking about, but SIA at that time was still a relatively new organization. Everyone knew the Securities Industry Association around here, so as a new member of Congress, I got taught very quickly that the SIA for a lot of people meant Securities Industries Association.

Charlie has been a long-time spokesperson for our industry, Mr. Chairman, and is very well-acquainted with public policy issues. In 1985 he conceived the basic idea behind SEMATECH, and he has been an ardent supporter and pusher of it. He has provided the leadership in the industry to form SEMATECH, and this was something then that was created and voted by the Semiconductor Industry Association and is something that he has a very strong feeling about.

In terms of his own company, they are a multinational company employing upwards of 22,000, 23,000 people now, I believe, Mr. Chairman, and they have a very major facility right in the heart of Silicon Valley, the area which I have the privilege to represent.

So again, Mr. Chairman, I thank you for the opportunity to introduce Mr. Sporck.

Mr. Valentine. Thank you, sir. We will be happy to hear from you at this time, sir.

Mr. Sporck. Thank you, Mr. Chairman. I am Charlie Sporck, chairman and chief executive officer of National Semiconductor. I am appearing today on behalf of the Semiconductor Industry Association, SIA. I currently chair a steering group established by the SIA's board of directors to develop a plan for Sematech. Sematech is a consortium of U.S. microelectronic firms designed to ensure that this country remains at the leading edge of semiconductor manufacturing technology.

I appreciate the opportunity to describe this industry initiative to you today. Before describing Sematech, I would like briefly to address the issue of need and how we got into the position of needing a Sematech.

I recognize that there has been a lot of testimony already this morning on that issue, and I won't really bore you extensively on that subject, but I would like to make a comment that I think that the semiconductor industry is a victim of its own importance. It is such an important industry that it has drawn the attention of our trading partners, such that a focused effort is applied in this area, out of proportion to what market return would bring our trading partners. And that has resulted over a period of years, especially in the case of Japan but not limited to Japan, because very clearly there are other trading partners who also are following the same basic strategy, has resulted in what I like to call a comparative advantage. A comparative advantage in the area of manufacturing. The United States semiconductor industry is indeed in a relatively good shape in the area of product design, product innovation, research and development, basic technology.

Where we have developed a disadvantage, where our trading partners, especially in the case of Japan, developed a comparative advantage, is in the area of manufacturing. And that's what Sematech is all about, is addressing in a major way the issue of the disadvantage we have in manufacturing.

On March 4, 1987, the board of directors of the Semiconductor Industry Association unanimously adopted an initial operating—operations plan for Sematech, developed by a working group to establish an industrywide consortium to strengthen American manufacturing capabilities in semiconductors.

This Sematech plan was consistent with the recent recommendation of the Defense Science Board, that the United States establish a semiconductor manufacturing technology institute which would develop, demonstrate, and advance the technology base for efficient high yield manufacture of state-of-the-art semiconductor devices.

We are currently evolving a detailed organizational and operational plan to be approved in early May by the SIA board of directors. The primary objective of Sematech is to develop future generation semiconductor processes, materials, tools, et cetera, and to transfer that knowledge to the member companies.

Sematech's emphasis will be on manufacturing capability, rather than device design. The joint approach entailed by Sematech, with the participants sharing in the results, will not only foster more efficient use of R&D dollars, but will result in the wider dissemination of state-of-the-art manufacturing technology throughout U.S. industry.

It is hoped that this initiative will help to ensure the future competitiveness of the domestic semiconductor industry by developing a strong supportive relationship with U.S. equipment and material industries.

Sematech will consist of three basic elements:

First, Sematech will conduct research and development on advanced semiconductor manufacturing techniques, including but not limited to—and there's a whole series of technical terminologies here. The research basis for these developments will be contributed under Sematech's direction by member companies, universities, national laboratories, and State-funded efforts. Overall guidance and direction of this Research effort will be provided by a research consortium, the Semiconductor Research Corporation.

Second, Sematech will test and demonstrate these techniques on an actual production line which will utilize a particular device, probably a memory device, as a technology driver.

Third, Sematech will develop techniques for adapting the processes which are proven on demonstration line to flexible manufacturing, so that manufacturing techniques developed in producing the technology driver can be applied to the manufacture of a wide variety of other products.

Sematech will not produce any semiconductors for commercial use. Its product will be technology and manufacturing skill, which individual participants will apply to their own needs. Sematech will be structured so that small companies, as well as large ones, can participate and share in semiconductor technology.

Sematech technology will be available to nonparticipants under licensing arrangement. The industry hopes to enlist the broadest possible base of financial support to include the U.S. Government, device makers, material suppliers, equipment manufacturers and users, and others as appropriate.

The financial requirements for Sematech will be substantial. We estimate that the Sematech facility will require funding of approximately $200 million in its first year of operation, and $230 million thereafter. These requirements are beyond the ability of any company or group of companies in this industry to satisfy.

Despite the heavy losses we have suffered in the past few years, we have maintained a high level of R&D expenditures. Some major U.S. firms are currently spending 20 percent of their sales revenues on R&D. We are finding it difficult to sustain this level of expenditure, yet on a world scale, it isn't enough.

Sematech is asking for the U.S. government to invest in a project with the industry on a similar 50-50 matching basis.

U.S. government participation in Sematech is an investment and should be distinguished from a subsidy or a bailout. Government funds will not flow directly to individual companies, or be utilized to cover the operating losses or expenses of individual firms. They will be used to purchase equipment and to finance R&D for Sematech, a not-for-profit entity which will not produce products for the commercial market.

Sematech's only product will be manufacturing technology and know-how that will be diffused through the U.S. semiconductor device, tools and materials industry.

Sematech will provide the U.S. industry with the learning by doing manufacturing know-how that they may otherwise—that may otherwise be lost as a result of the comparative advantage established by our trading partners.

Sematech will address a fundamental problem identified by the Defense Science Board, the fact that the U.S. semiconductor industry is being outspent in R&D by Government-subsidized foreign rivals.

I do not believe that government participation in Sematech would be a precedence for Government assistance in other U.S. industries which have suffered competitive reversals in the international arena. Semiconductors are uniquely important to an advanced industrial country, which is why they have been called the crude oil of the '80s.

As the Defense Science Board has made clear, semiconductors are increasingly central to our national defense. U.S. military forces are greatly outnumbered by the Warsaw Pact and must rely on the qualitative edge provided by semiconductor-based smart weapons, communications systems, and other force multipliers, to sustain a viable defense posture. The erosion of the U.S. semiconductor industry thus has grave national security implications.

U.S. Under Secretary of Defense Charles Fowler described the challenge facing the U.S. semiconductor industry as a critical national problem, that at some time in the future may be looked upon in retrospect as a turning point in the history of our nation. Sematech is a significant part of the U.S. industry's answer to that challenge. And I agree with Mr. Ferguson, Dr. Ferguson, in that it is not the complete answer. It is a part of the answer, but a very important part.

Thank you.

Mr. VALENTINE. Thank you, sir.

[The prepared statement of Mr. Sporck follows:]

TESTIMONY OF CHARLES SPORCK ON BEHALF OF THE SEMICONDUCTOR INDUSTRY ASSOCIATION

Mr. Chairman, I am Charles Sporck, Chairman and Chief Executive Officer of National Semiconductor. I am appearing today on behalf of the Semiconductor Industry Association ("SIA"). I currently chair a steering group established by SIA's Board of Directors to develop a plan for SEMATECH. SEMATECH is a consortium of U.S. microelectronics firms designed to ensure that this country remains at the leading edge of semiconductor manufacturing technology. I appreciate the opportunity to describe this industry initiative to you today.

I represent an industry that has for many years been held up as a model of American international competitiveness and entrepreneurial skill, as well as irrepressible individualism. During the past five years, however, we have become painfully aware that we confront an unprecedented challenge from trading partners such as Japan, where the government, working closely with powerful Japanese industrial groups, has established a semiconductor industry fundamentally unlike our own. This industry-government combination is increasingly defining the terms of international competition in microelectronics, and we have suffered some significant competitive setbacks. SEMATECH is this industry's most recent important response to that challenge—a recognition that in order to remain competitive internationally, we need to achieve a far higher degree of cooperation among ourselves.

THE BACKGROUND OF SEMATECH

It is worth reviewing at the outset the events which have brought us to the point where an effort such as SEMATECH has become necessary. Prior to the early 1980s, the U.S. semiconductor industry enjoyed technological preeminence in virtually every segment of the industry, and held the largest share of the world market. The upstream U.S. manufacturers of semiconductor production tools and materials were the acknowledged world leaders, an important factor underlying the competitive strength of the semiconductor industry itself. By 1986, however, this situation had changed dramatically. Japanese firms had captured a dominant share of the leading edge commodity memory devices (DRAMs, SRAMs, and EPROMs), and were becoming dominant in many of the upstream sectors as well. Japanese firms have now achieved a technological edge in many areas of semiconductor device and process technology, and are gaining on the U.S. in virtually every area.

Several factors underlie this dramatic structural change. Most importantly, since the early 1970s the Japanese government has made the "elevation" of the microelectronics sector a national priority. The industry has benefited from protection, de facto antitrust exemptions and a variety of forms of government financial aid. The government developed a close working relationship with the leading Japanese electronics producers, and a sucession of industry-government R&D projects, jointly funded by the government and Japanese companies, enabled Japanese firms to make dramatic technological strides.

As you know, the major Japanese semiconductor firms belong to large industrial groups, keiretsu, each headed by a major bank. They possess enormous financial resources. When a serious semiconductor recession develped in mid-1984, the Japanese firms began widespread dumping of commodity memory devices—most notably DRAMs and EPROMs. Both the U.S. and the Japanese industries suffered over $1 billion in losses during the period after mid-1984. However, because of their financial strength, the Japanese firms could absorb the massive losses which their below-cost sales caused. They were prepared to incur such losses for a protracted period because of the strategic nature of these products. They saw it as a means to obtain market share.

Like other private U.S. companies, U.S. semiconductor firms are unable to sustain below cost sales indefinitely—our economic system ultimately rewards firms that earn a return on their investment. In the face of Japanese dumping, most U.S. companies shut down their DRAM production after suffering what the U.S. International Trade Commission called "staggering" losses, and one major U.S. company, Mostek, ceased operations altogether. U.S. EPROM producers chose to "stand and fight," matching the Japanese prices, but in so doing, they suffered enormous losses. The collapse of much of the U.S. DRAM production and the erosion of U.S. EPROM capacity had a major ripple effect on the up stream tool and materials suppliers who experienced a contraction of their customer base while at the same time confronted an aggressive challenge by Japanese tool and materials suppliers.

The U.S. semiconductor industry responded to these developments by seeking trade policy measures to curtail the immediate threat posed by Japanese dumping as well as to improve U.S. access to the Japanese market. It is not clear at this point whether these efforts will succeed. However, even if they do, we recognize that even highly effective trade policy measures, by themselves, will not resolve the underlying competitive problems that have emerged in the past three years. We see the need for a series of measures collectively viewed as a "national strategy" to regain our competitive posture.

Most significantly, Japanese dominance of the commodity memory device markets has serious implications for U.S. manufacturing competitiveness. These products are "technology drivers," which are produced in high volumes and which are also highly complex. Mastering the manufacture of technology drivers enables producers to learn process improvements that can then be applied to the manufacturing of their other products, with corresponding improvements in yields, cost, and quality. As U.S. firms withdrew from these markets, this ability is being lost—a trend which threatens to produce a generalized loss of competitiveness unless major immediate steps are taken to reverse it.

Equally seriously, the operating losses of the 1985–86 period have diminished the resources U.S. semiconductor companies have available for investment in R&D and new equipment. Our capital and R&D investments have traditionally been financed primarily from our own reinvested retained earnings—but these have been severely reduced during the past three years. Intel's Robert Noyce observed in 1986 that his company's $175 million loss in that year was "a tax on our future. Our future products are not as good as they could have been. Our future manufacturing will not be efficient." [1]

To be sure, the U.S. semiconductor industry still spends a higher percentage of its revenues on R&D than any other manufacturing sector. The problem, as the Defense Science Board notes, is that by world standards this is no longer enough. We are not only being outspent by Japan in dollar terms, but are getting less R&D for our investment dollar, because much of our work duplicates the efforts of other firms.

SEMATECH is an initiative intended to address these fundamental concerns directly.

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[1] San Jose Mercury News, December 1, 1986.

THE SEMATECH INITIATIVE

On March 4, 1987, the Board of Directors of the Semiconductor Industry Association unanimously adopted an initial operations plan for SEMATECH developed by a working group to establish an industry-wide consortium to strengthen American manufacturing capabilities in semiconductors. This SEMATECH plan was consistent with the recent recommendation of the Defense Science Board that the United States establish a Semiconductor Manufacturing Technology Institute which would develop, demonstrate, and advance the technology base for efficient, high-yield manufacture of state-of-the-art seimconductor devices. We are currently evolving a detailed organizational and operational plan to be approved in early May by the SIA Board of Directors.

The primary objective of SEMATECH is to develop future generation semiconductor processes, materials, tools and test equipment, and to transfer that knowledge to the member companies. SEMATECH's emphasis will be on manufacturing capability rather than device design. The join approach entailed by SEMATECH—with the participants sharing in the results—will not only foster more efficient use of R&D dollars, but will result in the wider dissemination of state-of-the-art manufacturing technology throughout the U.S. industry. It is hope that this initiative will help to ensure the future competitivenes of the domestic semiconductor industry by developing a strong, supportive relationship with the U.S. equipment and material industries. SEMATECH will consist of three basic elements:

First, SEMATECH will conduct research and development on advanced semiconductor manufacturing techniques, including sub-micron lithography, deposition, advanced materials, etching, cleaning and epitaxy. The research basis for these developments will be contributed under SEMATECH's direction by member companies, universities, the national laboratories, and state-funded efforts. Overall guidance and direction of this research effort will be provided by our research consortium, the Semiconductor Research Corporatoin (SRC).

Second, SEMATECH will test and demonstrate these techniques on an actual production line, which will utilize a particular device (probably a memory devce) as a technology driver.

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The industry hopes to enlist the broadest possible base of financial support to include the U.S. government, device makers, materials suppliers, equipment manufacturers, end users and others as appropriate.

THE NEED FOR GOVERNMENT SUPPORT

The financial requirements for SEMATECH will be substantial—we estimate that the SEMATECH facility will require funding of approximately $200 million in its first year of operations and $230 million per year for five years hereafter. These requirements are beyond the ability of any company or group of companies in this industry to satisfy. Despite the heavy losses we have suffered in the past few years, we have maintained a high level of R&D expenditures—some major U.S. firms are currently spending 30 percent of their sales revenues on R&D. We are finding it difficult to sustain this level of expenditure, yet on a world scale, it isn't enough.

In Japan and Europe, where electronics firms affiliated with major banks have far greater financial resources than U.S. firms, governments nevertheless have frequently found it necessary to supply funding on at least a 50-50 matching basis in order to ensure the viability of major joint industry R&D efforts in micorelectronics. SEMATECH is asking for the U.S. Government to invest in the project with industry on a similar 50-50 matching basis. We would expect that SEMATECH would be sustained without U.S. government contributions by the end of a six-year period.

U.S. government participation in SEMATECH is an investment and should be distinguished from a subsidy or a bailout. Government funds will not flow directly to individual companies or be utilized to cover the operating losses or expenses of individual firms. They will be used to purchase equipment and to finance R&D for SEMATECH, a non-for-profit entity which will not produce products for the commercial market. SEMATECH's only "product" will be manufacturing technology and know-how that will be diffused throughout the U.S. semiconductor device, tools and materials industry.

SEMATECH will provide the U.S. industry with the "learning-by-doing" manufacturing know-how that may otherwise be lost as a result of the comparative advantage.

SEMATECH will address a fundamental problem identified by the Defense Science Board—the fact that the U.S. semiconductor industry is being outspent in R&D by government-subsidized foreign rivals.

I do not believe that government participation in SEMATECH would be a precedent for government assistance to other U.S. industries which have suffered competitive reversals in the international arena. Semiconductors are uniquely important to an advanced industrial country—which is why they have been called "industrial rice" and the crude oil of the 1980s."

DEFENSE IMPLICATIONS

As the Defense Science Board has made clear, semiconductors are increasingly central to our national defense. U.S. military forces are greatly outnumbered by the Warsaw Pact, and must rely on the qualitative edge provided by semiconductor-based "smart" weapons, communications systems, and other "force multipliers" to sustain a viable defense posture. The erosion of the U.S. semiconductor industry thus has grave national security implications.

CONCLUSION

U.S. Undersecretary of Defense Charles Fowler described the challenge facing the U.S. semiconductor industry as "a critical national problem that at some time in the future may be looked upon in restrospect as a turning point in the history of our nation." SEMATECH is a significant part of the U.S. industry's answer to that challenage. I look forward to working with you to make it a reality.

Mr. **Valentine**. Mr. Ritter?

Mr. **Ritter**. Thank you, Mr. Chairman. I'd like to thank the gentlemen for their excellent testimony. As the member of this committee who is also the sponsor, the author of the amendment in Energy and Commerce which did authorize $100 million a year for five years, which is to be reauthorized on receipt of the SIA report and the Commerce Department comments on that report, I am vitally interested in the subject here today.

There are critics, however, and I thought maybe it would be worthwhile to note who the critics are, what their claims are, and maybe I could get some responses from people like yourselves. The critics, like those in the Economists' March 7th issue, George Gilder, have stated that we really don't need to be in the mass scale production of semiconductors, DRAMS, as commodities; that what we really should be seeking and what we are achieving reasonably well are the specialized niche markets, the customer service orientation of semiconductors involved with microprocessors, and that here is the way the United States should go, and we shouldn't be involved in some of these other things, necessarily, and it's not overly unhealthy if we're not, and we shouldn't be cutting off our nose to spite our face by limiting the flood of these materials into the United States from foreign countries.

I'm sure all of you are aware of these arguments, and they have been articulated quite well by some of the critics. Could you comment? Could you please comment on this, starting off with Charlie Sporck.

Mr. **Sporck**. Okay. Actually, we are a manufacturer of many of those niche products, some of which I have read his comments in that subject, and many of the products he lists we wouldn't really consider niche. We certainly wouldn't consider microprocessors a niche area. But the problem of what we are trying to address with Sematech is a manufacturing disadvantage, and that applies to all semiconductor products. It doesn't matter whether you're dealing with a dynamic RAM or static RAM or some large volume logic product, or a niche device such as a hard disk controller. The manufacturing techniques that we need to apply there are relatively similar, and the state-of-the-art equipment developments that we have got to address, that we are falling behind on, in terms of our infrastructure in this country, are applicable to all those areas.

So it isn't enough to say we do not—you know, it isn't critical for us to be in the large volume commodity products, and focused over here on these small volume niche areas. The problem, the disadvantage we have applies just as strongly there as in the commodity area.

A broad—more broad answer to the whole economists' point of view, I find frankly very frustrating dealing with the economists, because I find that to a significant degree, their reaction to any discussion about our—the need for interest in our industrial base is taken as superfluous; that we don't really have to worry about our industrial base, as a main—as a matter of fact, we are now entering the age of services, we don't need an industrial base.

I don't know what the hell you trade with your trading partners if you have a service economy. I mean what do you ship to pay for your Toyotas? It's an irrational view that it's very difficult for somebody who lives in a world of hard trading issues, it's very difficult for us to deal with, with that kind of point of view.

Mr. Ritter. Any other comments on that particular line of criticism which has been used by some in this government to slow down the promotion of the ideas that we are talking about here?

Mr. Ferguson. May I be permitted?

Mr. Ritter. Yes, please.

Mr. Ferguson. Let me make two comments in roughly the same order that Charlie Sporck just made them.

First of all, with respect to the particular issue of the semiconductor case, and what we are leading in and what we are not leading in and so on——

Mr. Ritter. Well, you might also throw in the ideas that some of the critics have mentioned that if you don't include AT&T and IBM and the in-house producers of dynamic random axis memories, you are not giving a true picture of our market share. That, I think, is part of that whole——

Mr. Ferguson. Be happy to. With respect to the semiconductor issue, George Gilder is a very bright man, but somebody who switches from writing a book called "Sexual Suicide" in 1972 to writing a book about semiconductors in the 1980s is perhaps not the world's best guide to our competitiveness issue.

Mr. Valentine. Did you say "Sexual Suicide"?

Mr. Ferguson. Yes. Look it up, Mr. Valentine.

Mr. Ritter. But he also wrote a book called "Wealth and Poverty" in the interim.

Mr. Ferguson. He wrote one called "Wealth and Poverty," he wrote one called "The Spirit of Enterprise," and in one of those books—I don't remember which one—he celebrates an American semiconductor technology company called Micron Technology which has the dubious distinction of having losses equal to its revenues. It's difficult to celebrate a company like that, and——

Mr. **Ritter**. But beyond the personal aspects, what into the substance can we say?

Mr. **Ferguson**. Let us take some niche products, microprocessors, for example. In 1980, Japan had 10 percent of the world microprocessor market. Japan currently has 50 percent of the world microprocessor market.

There is a category of product called application-specific integrated circuits. It is very arcane, but it's extremely important for a variety of technical reasons that I won't go into here. In 1980, Japan had about 5 percent of the world market for application-specific integrated circuits. Japan currently has over 40 percent of the world market for application-specific integrated circuits.

And what Mr. Sporck said about manufacturing technology being a competitive disadvantage that cuts across every product category is completely correct.

Furthermore, with respect to the captive manufacturers such as IBM, AT&T, those companies do make their own semiconductors, but first of all, they do so at enormous cost; and second, they are completely or very heavily dependent upon the semiconductor capital equipment and materials industry which is in turn dependent upon the health of the entire semiconductor industry.

Mr. **Ritter**. And, which I might add, is coming out of Japan today.

Mr. **Ferguson**. Precisely.

Mr. **Ritter**. And in recent conversations with colleagues at AT&T, they told me they were worried about their production of 256K DRAMS, because since the equipment comes from Japan, they are worried about whether they are going to get the equipment in a timely enough fashion in order to be able to be competitive, even in their own in-house or their DOD contracts, which is the only external use they can make of their production. I'm sorry.

Mr. **Ferguson**. Not at all. You are exactly correct. The semiconductor equipment and materials industry is going away and losing its competitive advantage in the United States, just as fast or even faster than the semiconductor industry itself. And if IBM was our salvation, then one would think that IBM would be in general happy with its situation.

I can assure you from deep personal knowledge that IBM is very unhappy with its situation. And IBM is the most dedicated and fervent supporter of Sematech that one could possibly imagine.

Mr. **Ritter**. Interesting.

Mr. Maynard, do you have some comments with respect to DOD?

Mr. **Maynard**. I don't think there is any smaller niche market in the semiconductor business than the defense section of that market. We break even our small percentage up into lots of little individual pieces. They're critical to the defense systems, and there's no better way to make smart weapons unaffordable than to force us to have to build those components without a large manufacturing base and the knowledge that derives from it in small captive kinds of operations.

Mr. **Ritter**. Is what you are saying is that Gilder doesn't understand the trend lines in these areas and that he is simply missing the main point, that it is not just the commodity that is trending downward, but these other areas are under fierce attack as well? Is that in sum the reality?

Mr. **Sporck**. I don't think he's placing enough emphasis on the ability in a high tech area to build comparative advantage, and that once your trading partner has built to comparative advantage, there is no choice but to launch some counter to that comparative advantage.

Mr. **Ritter**. I agree.

Mr. **Sporck**. It takes government participation, as did the original comparative advantage building on the part of your trading partner. And I don't think he has come to grips with that.

Mr. **Ritter**. Mr. Sumney.

Mr. **Sumney**. I agree with everything that has been said. I think one point that maybe should be made is that in a cooperative venture such as SEMATECH, which is addressing the manufacturing disadvantage and will do research and development on the various processes associated with the production of semiconductor devices, there is the necessity, it appears, to select a product vehicle to demonstrate that indeed all these things have been done, so that the people who have participated, the industrial firms that have participated indeed feel they have gotten something in return. You have demonstrated that it works.

What you want to do is you want to select a production vehicle or a product vehicle that marries all of these things in the best way, in an optimum way, and whether it be a niche market product or whether it be a high commodity product, that is not really important. It is not something that is going to be commercialized; it is simply a demonstration vehicle that indeed all these processes have been tied together.

So I think perhaps if that comment is indeed focused toward SEMATECH, he simply misunderstands the objective of what is trying to be done.

Mr. **Ritter**. It is not necessarily focused toward SEMATECH but focused toward the general health of the industry.

Do we need antitrust changes and shifts in order to have SEMATECH hit the ground running early so that we don't hit Justice Department opposition once we are organized?

Mr. **Sporck**. We do not have the complete description of our organization as yet, although we are very close, and certainly one of our concerns is the antitrust issue, and certainly that is one that we are forecasting we are going to need help on.

Mr. **Ritter**. Mr. Chairman, I thank you.

I have a series of questions that I have developed that I would like to submit for the witnesses. They are an extensive series of questions but I think would help to really develop the record of these hearings.

Thank you, Mr. Chairman.

Mr. **Valentine**. Without objection.

Mr. Price.

Mr. **Price**. Thank you, Mr. Chairman.

I want to thank all the witnesses for some very helpful testimony. I would like particularly to welcome Mr. Sumney here and to focus my questioning, if I might, on his testimony.

Mr. Sumney since 1982 has been the director of the Semiconductor Industry Association and thus has extensive first-hand experience with the kind of intra-industry cooperation that is envisioned by a number of these proposals that we are looking at.

I was noticing in his biographical sketch that the SRC has involved 60 participating companies, made over $100 million available to support this integrated semiconductor research program, which has involved some 40 U.S. universities and several hundred faculty members and over 400 graduate students. So that is a very impressive venture in intra-industry cooperation, and it leads me to my question about the National Advisory Committee proposal that we have been discussing.

I congratulate Mr. Valentine on his initiative in putting forward that proposal, and I am glad to associate myself with it.

I wonder, Mr. Sumney, if you could talk a little bit about the cooperation that that proposal presupposes among these companies. A skeptic might wonder if those companies can really get together, if these independent and highly profitable companies could really get together and cooperate in a productive way, or whether there might be problems we could anticipate of competition, secrecy and so forth that would make the functioning of this advisory committee difficult.

I guess the question I am asking is whether there is sufficient incentive within the industry to undertake a cooperative venture of that sort. Could you comment on that?

Mr. SUMNEY. Yes. My perspective is unique, I think, in viewing the semiconductor industry from a cooperative venture such as the SRC. We have seen within the SRC this cooperative spirit become more enthusiastic as joint R&D is discussed, joint basic research programs are discussed, industrial goals are integrated and set forth for where this industry wants to be ten years henceforth, and what research is necessary to enable it to get there.

So we have seen this grow, and I don't think there is any reason to suspect that the industry wouldn't be in a position to cooperate on something like the proposed National Advisory Committee on Semiconductors.

What we are really trying to do in many of these areas is to create a new type of knowledge. In the past there has been proprietary knowledge and there has been public knowledge. We are trying to put in the middle here a new body of shared information that is not related to product design or product sales but is related to what everybody recognizes is generic to the industry: specifications, standards. Many things that each company needs, each company develops on their own could be done more efficiently and effectively if these things were done one time and then shared.

So we have seen this cooperative spirit grow. I participate on the SEMATECH Steering Committee and on one of its task forces, and working with that group it is clear that the cooperation, the cooperative spirit is there, and I don't see any reason why it couldn't be extended to the Advisory Committee on Semiconductors.

Mr. Price. Could you comment a bit on the SEMATECH initiative and the way in which this advisory committee that you envision would coordinate with the SEMATECH initiative? Are those complementary efforts?

Mr. Sumney. I think in order for either one to work well, there has to be a link. My testimony reflected that we need an overall strategy to make our industry more competitive. Each of the elements you have just mentioned is an element of that strategy. The establishment of the Advisory Committee is an element of the strategy. I think that has to be done.

SEMATECH is another element of the strategy. Better utilization of the national laboratories is another element of the strategy. With respect to the two that you mentioned, I think that the Advisory Committee on Semiconductors would indeed provide guidance and advice to the management structure of SEMATECH, and I think that SEMATECH would indeed take that advice to heart and pay some attention to it if it is staffed with the prestigious kind of people that the bill specifies it should be.

Its influence is going to come from the people that are put on that committee. They have to be recognized as experts in their arena, and if that is done and if it is given the proper staff support to develop positions that are respected positions, then I think it will work and work well.

Mr. Price. You mentioned some of the precedents for this kind of advisory structure. I remember from my own staff work on the Senate side the Advisory Committee on Oceanography back in the 1960's, which certainly made a major contribution toward integrating that research enterprise and promoting it.

Could you comment a bit on the kind of precedence that exists for this kind of advisory committee which leads you believe that this is the optimal kind of structure?

Mr. Sumney. Well indeed, the one that you just mentioned, I think, is a precedent that indicated that such a thing would work. The one that we focused on when this was first presented was the National Advisory Council on Aeronautics. It is an older one. It was established in 1917 or 1918, but it did ensure that this country has led in aviation for that intervening time period, from then until now. I think it played a very key role in making that happen.

So I think that it is also a precedent. It evolved into something that this committee may indeed never evolve into, but at least at the beginning I think there is commonality and it is a good analogy.

Mr. Price. Again, my congratulations for your leadership. We look forward to continuing to work with you as we work through these various organizational initiatives.

Thank you, Mr. Chairman.

Mr. Valentine. Mr. Mineta.

Mr. Mineta. Thank you very much, Mr. Chairman.

First of all, I would like to ask—and I am not sure who the proper witness would really be to respond to this. Given the fact that the defense industry comprises about 10 percent, I guess, of the total consuming portion of the semiconductor industry, I am wondering whether or not going to DOD for 50 percent of the funding for SEMATECH isn't an overreach in terms of the amount that is being requested of DOD, recognizing that DOD is a better deep pocket than anywhere else, but I am just wondering whether or not you want to engage yourself in that kind of imbalance, I guess you might refer to it as.

Mr. Sporck. Maybe Mr. Maynard would respond to that. Speaking for the companies that are involved in SEMATECH, obviously it is the deep pocket issue. Beyond that, there is a clear understanding in DOD of the importance of this industry. Once you leave DOD, it gets a little grey in terms of the clear understanding.

The Defense Science Board's study and the recommendations clearly state the criticalness of this industry. So it is almost natural for us to go in that direction.

What are the alternatives?

Mr. Mineta. Now, the VLSIC program was done primarily just within the industry, but VHSIC was done at DOD? Is that a very large-scale—is that more on the private side, and then when it got into the VHSIC, then it went more into an organized program within DOD?

Mr. Maynard. VLSI is a generic term for the level of complexity of the integrated circuits. VHSIC was a DOD program. It is just the name of a program, not necessarily a class of circuits. It was based on——

Mr. Mineta. VHSIC stands for very high speed?

Mr. Maynard. Very high speed, yes. The goal of the program was to correct a problem the Defense Department has in that the VLSI technology coming out of industry was emerging faster than we knew how to deal with it. Consequently, we developed an engineering program to develop our own products, to translate the fabrication technology the industry was producing into specific products for defense.

The assumption we made in 1980 when we started the program was that there was a large, healthy, viable industry in this country from which all that manufacturing technology would emerge, and we didn't have to worry about that or pay anything for it. Now, as we are entering into the second generation of the integrated circuits in the VHSIC program, we discover, not overnight, but we realize how critical the problem has become, and that assumption is no longer true.

When we get to the 1990s and need products in our weapons systems that we are paying to design with programs like VHSIC and others, we can't assume that there will be an industry in this country that can efficiently manufacture those weapons cheaply enough so that we can afford them.

Mr. Ritter. Will the gentleman yield on that point?

Mr. Mineta. Absolutely.

Mr. Ritter. What is the impact of the loss of the consumer electronics industry in this country? Have we lost that manufacturing preeminence because we have lost so much of consumer electronics?

Mr. Ferguson. If I might.

By the way, before I answer your specific question, I would like to apologize for the strength with which I make my remarks. Unfortunately, it is difficult to find a subject about which I feel more strongly than this one, and what you are seeing is a reflection of that.

Mr. Ritter. We are delighted to have you here.

Mr. Ferguson. Thank you.

Mr. Sporck. Gilder already took care of the one other one.

Mr. Ferguson. Yes.

Mr. Valentine. Would you like for us to send the gentleman a copy of this testimony? [Laughter.]

Mr. Ferguson. Believe it or not, he and I talk fairly frequently.

With respect to consumer electronics, the consumer electronics issue, I think, is fairly important for two reasons. Having said it is fairly important, it is not clear what we can do about it because it is a huge industry and we have already lost it and we are not going to get it back tomorrow morning, but it is fairly important for two reasons.

One simply that consumer electronics is a very big market. It constitutes about 40 percent of Japanese semiconductor demand, and that is a lot, especially since the Japanese semiconductor market, by the way, is now larger than the United States semiconductor market in absolute terms.

The second thing is that consumer electronics, or shall we say consumer products more generally are now at the leading edge of the technology in some cases. Not in all cases, but in many cases they are at the leading edge of the technology.

Now, if the only way to get that back is to get consumer electronics back, then we are in trouble. However, I think that there are at least two other ways. One is simply to go through a mechanism like SEMATECH so that we have some other way of funding very advanced technology development and getting manufacturing technology up to where it would be if we had a consumer electronics industry.

Mr. Ritter. For which market?

Mr. Ferguson. For anything that uses semiconductors. Now, one component of that, of course, is whether we will have access to the Japanese market, which is continuing to grow more rapidly than our own, will continue, probably, to grow more rapidly than our own, is now larger than our own, and from which we are now largely excluded.

Mr. Mineta. May I reclaim my time at that point just to follow up on that point? What I see is an imbalance. We are going to DOD because of deep pocket. They only represent 10 percent of the customer stream. What I see the Japanese doing is putting their money into the consumer piece of it, and now we have got a $170 billion trade deficit, $58 billion of it with Japan. Our minds are all being put into the DOD engineering scheme, and their engineering skills are being put into the civil economy.

I am just wondering whether or not we are not going down some kind of a primrose path saying DOD has got the money, let's go and grab the money there. When we go down that way, we find generally that DOD is more expensive in terms of the way they have to do things, more time consuming.

Then the other piece of it is technology transfer. If it is in DOD, it is classified and we cannot get it into the civil economy. If it is in NSF or some other place, it may be more easily transferable in terms of the civil economy, where we will get a return back. We are not in the market, I don't think, or I am not in the market to buy an Enterprise or a missile. It is not a consumer product.

So I am just wondering. Again, I recognize the need for the R&D and I think that is what we sort of have to sort out. What are we after? What is it we are really after in this thing? I mean, heck, if it is money we need, then that is one point. Do we have to sell our souls—excuse me, Mr. Maynard—to the DOD for 10 percent of product in order to get 50 percent of the money?

Mr. RITTER. Would the gentleman yield?

Mr. MINETA. Certainly.

Mr. RITTER. The gentleman was not present, I do not think, at my testimony on my bill, the National Bureau of Standards in Industrial Competitiveness yesterday morning.

Mr. MINETA. I was not.

Mr. RITTER. I did quote from Dr. Ferguson's publications and, of course, you have written extensively on this very aspect. And one of the reasons we did it in the Energy and Commerce Committee, we did the amendment there was because we felt that Commerce would be closer to the domestic economy, the civilian economy; but after listening to testimony yesterday on the interest of Commerce in technology and advancing technology, I think we all came away pretty disillusioned that that was the appropriate place, so I think we do have some interesting decisions to make as to where the responsibility for this should lie. We don't have a National Bureau of Standards in Industrial Competitiveness, a National Technology Institute yet, and we probably won't by this summer, you know. NSF is starting to look a little better all the time, but I yield back, and I thank the gentleman for yielding.

Mr. MINETA. Because I remember having a long discussion with Mr. Packard about this whole issue when we were getting into the very high speed integrated circuit business, as to whether or not we want the DOD to go down that route. At that time he was saying no, let the civil side take care of it, let the private sector do it, and because again this was this whole issue at one time about hey, do we want to be in the position of picking winners and losers. We are over that hump. You know, we're so behind that hump now we're not even worried about that. We've got other fish to fry, and now we are talking about where is the best place to get the money and how do we get this done.

But I just wonder whether or not we want to get wrapped up in the DOD approach on this thing.

Mr. SPORCK. I would like to make a couple of comments here, Mr. Congressman. You have to keep in mind that what we are talking about when we deal—when we discuss SEMATECH is we are talking about developing manufacturing technology. We're not developing products. We're developing manufacturing technology. And my understanding of DOD restrictions on the flow of that kind of R&D is reasonable, from an independent company, a commercial company's viewpoint; that that technology can go to the infrastructure and to the member companies in a commercial fashion.

Mr. MINETA. Charlie, if you went down and talked to your division that handles export licensing, would you get the same response?

Mr. **Sporck**. I—the export—you know, I don't want to defend the export licensing issues, because I spent a lot of time trying to knock them down.

Mr. **Mineta**. So do I.

Mr. **Sporck**. However, we have to deal with realities here. I—you know, we can sit back and have a philosophical discussion over the next couple of years in terms of where the funding is going to come from and it really ought to come from commercial areas, we really ought to, you know, address the major—the broader issue of the whole industrial base versus just the semiconductor industry.

Our problem, speaking for the semiconductor industry, is the timing is right now. We have got to do something and we have got to do something right now. We don't know how else to do it, other than the approach that we are currently taking. I don't know where else you are going to get funding in a reasonable period of time, other than, you know, DOD.

If that funding doesn't occur, you know, until next year or the year after, we can all save ourselves a lot of time and effort and money by, you know, putting off permanently the discussion.

Mr. **Mineta**. Mr. Chairman, let me get into some of this—I'm sorry, Mr. Maynard?

Mr. **Maynard**. May I comment on that? Just as a viewpoint, not on whether defense is the best segment of the bureaucracy to do anything, but on this subject of semiconductors and advanced technology. It is not because the Defense Department specifies some new generation of weapons that semiconductor technology emerges; and, in like manner, it is not because the consumer electronics specifies some new product or computers. It's the other way around. It's whatever technology emerges on the factory floor in that manufacturing technology that defines what the next generation of computers and consumer electronics and weapons can do, and that, in effect, it doesn't matter who pays for that basic element of it, for the last 30 or 40 years the Defense Department received it all for free. We didn't have to pay for that.

What the Defense Science Board said was that if nobody else is going to pay for it, the Defense Department has to because we need that technology for the weapons.

Mr. **Mineta**. Let me get into the SEMATECH itself, then. Will there be—I don't know, a laboratory built, or is this done by contract with universities and private companies? What is envisioned here for——

Mr. **Sporck**. Yes. We are talking about a—you know, really two efforts in SEMATECH. One is a development effort, and that development effort will occur in a laboratory, an environment that actually exists in a site, a SEMATECH site. It will also occur through subcontracts to the infrastructure, the equipment industry, the materials of the world. It will also occur through SRC in universities, in hopefully government laboratories.

There will also be an additional portion which is the demonstration portion, a very critical portion of this effort, where the products of the development will be actually demonstrated in a real life manufacturing facility, again at this SEMATECH site, such that the members can come in and specifically see the products of that development, so that they don't have to go away and redevelop, re-prove, the same effort. You can do it once for the whole consortium.

There is another portion which is a very critical one, that's how you go about transferring the products of this development and this application.

Mr. **Valentine**. Mr. Mineta, do you have any further questions?

Mr. **Mineta**. You have been very generous with me in terms of time, Mr. Chairman, and I yield back my remaining time. [Laughter.]

Mr. **Valentine**. Well, I want to say to the gentleman that speaking for this chairman, you can have all the time that you want. We—

Mr. **Mineta**. That's only because I chair another subcommittee that he happens to sit on. [Laughter.]

Mr. **Valentine**. We—I just—we come to the end of a long journey, and I have one or two general questions, and a statement to make, and then as far as I am concerned, we will be finished with this.

I want to say with respect to this H.R. 2191, which we introduced yesterday, every member of the committee who sits here now—Mr. Price was here earlier and he departed—co-sponsored that legislation. And I am not a scientist. In my other life I was a country lawyer, and I didn't come to Congress with a burning desire to introduce a piece of legislation to create a national advisory committee on semiconductors. I didn't know much about that sort of thing until I got this federal job, and got on this committee, and so what I am trying to say is that this is an effort to be helpful. It is a difficult task to pass legislation through this Congress. And I would ask each one of you gentlemen who are seated here, and others who have testified, to please examine that initiative, and let us have your views on it. If you think it—the Congress should pass it, tell us so, and I'd like you to respond to this committee, if you would, with a separate letter to me so that we may know. If it is not what you think we should do, we don't present it as some kind of panacea or a utopia. We just see it as a way to approach the problem from one perspective, one point of view.

I know there are a lot of people that say well, you appoint another commission or committee. We want to do something that is meaningful. I don't think that Congress has enough information, and we certainly do not have enough oneness of will to approach the problem. So we either do nothing or we say, well, somehow in some way the Lord will protect us and American industry will get together and they will do what has to be done, and blah, blah, blah. Or we do nothing, as I said. Or we try to become acquainted with the problem. We try to get some experts together who can make recommendations. That's what we seek to do.

Two final questions to Mr. Sumney, primarily.

How much support do you believe that this proposal will have from the industry? You just asked for support. How much do you think that this proposition really has?

Mr. **Sumney**. It's difficult to speak for the industry. I can give you my impressions.

Mr. **Valentine**. Mr. Sumney, I think if you use the microphone, it may help.

Mr. **Sumney**. I sat on the Science Board Task Force on semiconductor dependency, and as I indicated in my testimony, one of their conclusions was that such an advisory body be established.

Companies such as IBM, Martin Marietta, TI and others were represented on that task force, and I assume that they endorsed the recommendations and conclusions. So from that standpoint I think there's evidence that a certain set of companies support it.

Also from the standpoint of discussions that have occurred within the SRC and within the SIA, I have seen reasonable support. I don't think there has been an official polling of companies to ask them if they support it. I did present the concept at a November SIA meeting, a board meeting, and at that time all the comments were positive comments from companies that were in the audience, one of them being National Semiconductor, and of course Charlie can speak perhaps better than I for the industry, and he certainly can speak for National Semiconductor.

Mr. **Sporck**. Speaking for National and the group that's been working on SEMATECH, I think you are going to get a lot of support. I think it—this is a needed step toward addressing the problem. You will see a lot of support in the industry.

Mr. **Valentine**. Thank you, sir.

Does anybody else have any other comment, anything else for the good of the order?

If not, I want to say for all the members of this subcommittee and for the full committee, that we appreciate very much you gentlemen taking the time to prepare yourselves to come here and to share this knowledge and information with us. And this committee will reconvene at 9:30 tomorrow morning in this room for further proceedings.

We are now adjourned.

[Whereupon, at 1:10 p.m., the subcommittee was adjourned.]

THE ROLE OF SCIENCE AND TECHNOLOGY IN COMPETITIVENESS

THURSDAY, APRIL 30, 1987

House of Representatives,
Committee on Science, Space, and Technology,
Subcommittee on Science, Research and Technology,
Washington, DC.

The subcommittee met, pursuant to notice, at 10 a.m., in room 2318, Rayburn House Office Building, Hon. Doug Walgren (chairman of the subcommittee) presiding.

Mr. Walgren. Well, let me call us to order, and first I'm sorry that we weren't able to start on time today. Something has happened to the traffic almost citywide, I understand, but certainly there was a really unusual bumper-to-bumper stream on the route that I come in, and I apologize for that.

This is the third day of hearings on competitiveness. As most of you know, this Subcommittee has had an interest in this area over the past four years and has taken a number of initiatives which would be billed as competitiveness initiatives if they were being proposed for the first time today.

We were active in the area of transfer of federal technology to the private sector, in federal patent policy and in procuring and disseminating scientific and technical information. Certainly these are the areas that we continue to need to move forward in today.

We are particularly fortunate that Congressman Boehlert and Congresswoman Schneider, Congressman MacKay, and Senator Bumpers have done some very important thinking for us in the area of technology transfer. They have a piece of legislation to create a clearinghouse in the Office of Productivity, Technology and Innovation for state technology promotion efforts, and that will be considered certainly carefully this morning, as will the Boehlert and MacKay bill, which sets up a matching grant program and a technology dissemination office in the National Bureau of Standards.

We also want to explore two recent developments in the Executive Branch. We are particularly pleased to have Dr. William Graham, the President's Science Adviser, with us today to review the President's recent Executive Order to implement the Federal Technology Transfer Act of 1986, and we are pleased that Michael Farrell, the General Counsel of the Department of Energy, will be with us today to tell us about the Department's plans to implement that recent Executive Order and recently issued regulations implementing the 1984 Federal Patent Legislation which came out of this committee.

We have a distinguished group of private sector witnesses as well, and we appreciate all their contributions to this discussion.

Over the past three days it is clear there is no shortage of good ideas related to competitiveness, but we face the difficult job of developing the breadth of consensus that is necessary for any idea in our country to become law.

I understand that Congressman Wyden and Senator Bumpers were unable to be here, but we will insert their remarks at the proper place in the record. Mr. Wyden was here, but had to leave, but with that, let me recognize the ranking Minority member, Mr. Boehlert.

[The prepared statements of Senator Bumpers and Congressman Wyden follow:]

TESTIMONY OF SENATOR DALE BUMPERS

BEFORE THE SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

APRIL 30, 1987

LEARNING FROM THE STATES ON COMPETITIVENESS

MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE, I AM DELIGHTED TO APPEAR TODAY TO DISCUSS HOW WE CAN HELP TO MAKE AMERICAN MORE COMPETITIVE.

LET ME BEGIN BY SAYING HOW PLEASED I AM THAT CHAIRMAN WALGREN AND CONGRESSMAN SCHNEIDER HAVE AGREED TO INTRODUCE THE PROPOSAL I HAVE INTRODUCED IN THE SENATE TO ESTABLISH A CLEARINGHOUSE ON STATE AND LOCAL COMPETITIVENESS INITIATIVES. IN THE SENATE THE BILL'S NUMBER IS S. 930 AND IT WAS INTRODUCED ON APRIL 7, 1987.

IN THE CURRENT DEBATE ON HOW TO ASSIST OUR INDUSTRIES AND BUSINESSES TO REGAIN THEIR COMPETITIVE EDGE IN THE INTERNATIONAL MARKETPLACE, THERE IS VERY LITTLE CONCENSUS HERE IN WASHINGTON ON HOW TO PROCEED AND THE MASSIVE FEDERAL GOVERNMENT BUDGET DEFICITS SEVERLY CONSTRICT OUR OPTIONS.

THE DEBATE ON COMPETITIVENESS IS LACED WITH IDEOLOGICAL ISSUES ABOUT THE PROPER ROLE OF THE FEDERAL GOVERNMENT. UNFORTUNATELY, THE DEBATE OFTEN FOCUSES ON THE EXTREMES, WITH ADVOCATES ON THE ONE SIDE

ARGUING THAT THE FEDERAL GOVERNMENT SHOULD DO NOTHING AND ADVOCATES ON THE OTHER ARGUING THAT THE FEDERAL GOVERNMENT SHOULD INTERVENE ACTIVELY IN THE MARKETPLACE. I BELIEVE FIRMLY THAT THERE IS A PRAGMATIC MIDDLE-GROUND IN THIS DEBATE WHICH HAS NOT BEEN FULLY EXPLORED.

WE CAN, FOR EXAMPLE, TAKE A POSITIVE AND CONSTRUCTIVE STEP WHICH DOES NOT INVOLVE ESTABLISHING ANY NEW FEDERAL POLICY OR WHICH DRAINS THE TREASURY. WE AT THE FEDERAL LEVEL OF GOVERNMENT CAN PLAY A CONSTRUCTIVE ROLE WHICH DOES NOT IMPOSE A TOP-DOWN NATIONAL INDUSTRIAL POLICY. THE FEDERAL GOVERNMENT NEED NOT BECOME A LENDER OF LAST RESORT TO EVERY BUSINESS WHICH IS ADVERSELY AFFECTED BY INTERNATIONAL COMPETITION.

SPECIFICALLY, LEGISLATION I INTRODUCED ON APRIL 7, S. 930, WOULD ESTABLISH A NATIONAL CENTER IN THE COMMERCE DEPARTMENT TO SERVE AS A CLEARINGHOUSE TO MONITOR AND ASSIST STATE AND LOCAL GOVERNMENTS WITH THEIR INITIATIVES TO STIMULATE PRODUCTIVITY, TECHNOLOGY AND INNOVATION.

THE CENTER ON STATE AND LOCAL INITIATIVES ON PRODUCTIVITY, TECHNOLOGY AND INNOVATION WILL HELP ALL OF US TO ENHANCE THE COMPETITIVENESS OF OUR COUNTRY IN INTERNATIONAL TRADE WITHOUT ERECTING NEW TRADE BARRIERS TO IMPORTS OR LAUNCHING MASSIVE AND UNTRIED FEDERAL GOVERNMENT PROGRAMS.

THIS MODEST PROPOSAL WILL HELP ALL OF US TO LEARN FROM THE PRACTICAL PROGRAMS THAT STATE AND LOCAL GOVERNMENT AGENCIES ARE

UNDERTAKING TO ASSIST OUR INDUSTRIES AND BUSINESSES TO REGAIN THEIR COMPETITIVE EDGE. THE CENTER'S SERVICE AS A CLEARINGHOUSE WILL HELP THE STATE AND LOCAL GOVERNMENTS TO LEARN FROM ONE ANOTHER ABOUT WHICH OF THEIR INITIATIVES ARE THE MOST EFFECTIVE AND MOST COST EFFECTIVE AND IT WILL BE VALUABLE TO THOSE OF AT THE FEDERAL LEVEL WHO ARE SEEKING TO DEVELOP A CONCENSUS ON HOW TO PROCEED ON THIS CRITICAL ISSUE.

WE HAVE CHOICES OTHER THAN DOING NOTHING AND DOING TOO MUCH. WE NEED NOT IGNORE THE ISSUE, AS THIS ADMINISTRATION HAS DONE. WE CAN PURSUE A MULTI-FACETED, BOTTOM-UP COMPETITIVENESS STRATEGY. WE CAN AVOID CENTRALIZING THE STRATEGY-MAKING PROCESS. WE CAN BE PRAGMATIC, WE CAN AVOID IDEOLOGY AND WE CAN COME TOGETHER AS A NATION TO DO WHAT MAKES SENSE AND WHAT IS NECESSARY TO ADVANCE OUR NATIONAL SELF INTEREST.

WE DO NOT HAVE TO WAIT UNTIL THERE IS A CONCENSUS AT THE FEDERAL LEVEL ABOUT HOW WE CAN BE HELPFUL IN ENHANCING COMPETITIVNESS. THE STATE AND LOCAL GOVERNMENTS ARE NOT WAITING FOR THE FEDERAL GOVERNMENT TO ADDRESS THE CHALLENGE OF COMPETITIVENESS. THEY KNOW NOT TO EXPECT ACTION FROM THIS ADMINISTRATION.

A CLEARINGHOUSE CAN BE HELPFUL NOW AND IT IS THE MINIMUM STEP WE SHOULD TAKE TO INFORM OURSELVES AND SUPPORT THOSE WHO ARE NOT ABLE OR WILLING TO ACT ON A CRITICAL CHALLENGE TO THE ECONOMIC WELL-BEING OF OUR NATION.

STATE AND LOCAL GOVERNMENT INITIATIVES

ON THE ISSUE OF COMPETITIVENESS, STATE AND LOCAL GOVERNMENTS ARE DEMONSTRATING MUCH MORE CREATIVITY THAN IS THE FEDERAL GOVERNMENT. THEY ARE SHOWING THAT THEY UNDERSTAND HOW SERIOUS THE COMPETITIVENESS CHALLENGE IS FOR AMERICA AND THEY ARE ACTING BOLDLY AND PRAGMATICALLY TO BRING THE PUBLIC AND PRIVATE SECTOR TOGETHER IN A CONSTRUCTIVE PARTNERSHIP TO MEET THIS CHALLENGE.

-- MANY STATES AND LOCAL COMMUNITIES ARE ESTABLISHING BUSINESS "INCUBATOR" CENTERS FOR ENTREPRENEURIAL ACTIVITY, OFTEN IN CONJUNCTION WITH STATE UNIVERSITIES AND PRIVATE FOR-PROFIT CORPORATIONS. THESE CENTERS ARE DESIGNED TO NURTURE SMALL BUSINESSES BY LOWERING THEIR OVERHEAD COSTS WITH SHARED SUPPORT SERVICES AND PROVIDING ON-SITE MANAGEMENT ASSISTANCE AND SUPPORT. THERE NOW ARE AT LEAST 148 CENTERS IN 33 STATES. ("'INCUBATORS': A SMALL BUSINESS CASE STUDY," WASHINGTON POST, JUNE 30, 1986.)

-- REGIONAL ORGANIZATIONS ARE COMING TOGETHER TO FUND SHARED FLEXIBLE MANUFACTURING FACILITIES, WHICH ARE CAPABLE OF MAKING A WIDE VARIETY OF PRODUCTS, WITH LEASES FOR PRODUCTION TIME BEING GIVEN TO VARIOUS SMALL BUSINESSES. THE NATIONAL GOVERNORS ASSOCIATION, THE WESTERN GOVERNORS ASSOCIATION AND THE SOUTHERN GROWTH POLICIES BOARD HAVE BEEN ACTIVE IN ORGANIZING COMPETITIVENESS INITIATIVES ON A NATIONAL AND REGIONAL BASIS.

-- ARKANSAS HAS A SCIENCE AND TECHNOLOGY AUTHORITY, NEW YORK HAS A SCIENCE AND TECHNOLOGY FOUNDATION, MICHIGAN HAS SEVERAL CENTERS OF EXCELLENCE, AND PENNSYLVANIA HAS A BEN FRANKLIN PARTNERSHIP. OHIO, ILLINOIS, NEW JERSEY, KENTUCKY AND MANY OTHER STATE ARE ACTIVE

IN PROMOTING COMPETITIVENESS. THEY ARE NOT WAITING FOR THE FEDERAL GOVERNMENT TO STEP IN WITH FUNDS OR PROGRAMS.

-- THERE ARE AT LEAST FORTY-SIX STATES WITH CUSTOMIZED TRAINING PROGRAMS ON A FIRM-BY-FIRM BASIS FOR NEW OR EXPANDING COMPANIES. UNDER THESE PROGRAMS THE STATE SCHOOLS AND UNIVERSITIES WORK WITH PRIVATE EMPLOYERS TO DELIVER THE REQUIRED TRAINING. THESE TRAINING PROGRAMS CAN BE USED TO INTRODUCE MORE PRODUCTIVE TECHNOLOGIES TO THOSE IN TRAINING.

THE RANGE OF INITIATIVES IS SO BROAD THAT THERE IS NO COMPREHENSIVE LIST OF THE INITIATIVES WHICH HAVE BEEN UNDERTAKEN BY STATE AND LOCAL GOVERNMENTS TO ENHANCE COMPETITIVENESS. THERE ARE SOME USEFUL RESOURCES WHICH DOCUMENT THE RANGE OF THESE INITIATIVES BUT NONE OF THEM IS COMPREHENSIVE.

-- THE NATIONAL GOVERNORS ASSOCIATION HAS PUBLISHED ONE USEFUL COMPENDIUM, "REVITALIZING STATE ECONOMIES: A REVIEW OF STATE ECONOMIC DEVELOPMENT POLICIES AND PROGRAMS."

-- THE OFFICE OF TECHNOLOGY ASSESSMENT HAS PUBLISHED ANOTHER, "TECHNOLOGY, INNOVATION, AND REGIONAL ECONOMIC DEVELOPMENT."

-- THE COMMITTEE FOR ECONOMIC DEVELOPMENT HAS PUBLISHED "LEADERSHIP FOR DYNAMIC STATE ECONOMIES," THE PRESIDENT'S COMPETITIVENESS COMMISSION ISSUED "INNOVATIONS IN INDUSTRIAL COMPETITIVENES AT THE STATE LEVEL," THE AMERICAN ASSOCIATION OF STATE

COLLEGES AND UNIVERSITIES HAS PUBLISHED "THE HIGHER EDUCATION-ECONOMIC DEVELOPMENT CONNECTION," THE COMMERCE DEPARTMENT HAS ISSUED A "GUIDE TO INNOVATION RESOURCES AND PLANNING FOR SMALLER BUSINESSES," AND THE SMALL BUSINESS ADMINISTRATION HAS DOCUMENTED "STATE ACTIVITIES IN VENTURE CAPITAL, EARLY-STATE FINANCING AND SECONDARY MARKETS."

BUT, THE RANGE OF THESE INITIATIVES IS TOO BROAD, THE PROGRAMS ARE CHANGING TOO QUICKLY, AND THE FEDERAL GOVERNMENT HAS TOO LITTLE INTEREST IN MONITORING THESE DEVELOPMENTS FOR US TO HAVE EVEN A COMPLETE LIST, LET ALONE AN UNDERSTANDING, OF WHAT IS HAPPENING NOW AT THE STATE AND LOCAL GOVERNMENT LEVEL.

WE DO KNOW ENOUGH, HOWEVER, ABOUT THESE INITITIVES TO KNOW THAT SOMETHING EXCITING IS HAPPENING AT THE STATE AND LOCAL GOVERNMENT LEVEL. WE KNOW THEY ARE EXPERIMENTING WITH NEW APPROACHES TO THE RESPONSIBILITIES OF GOVERNMENT, WE KNOW THEY ARE TAKING RISKS, AND WE KNOW THAT THEY ARE CHALLENING THE TRADITIONAL NOTIONS ABOUT THE RELATIONSHIP BETWEEN THE PUBLIC AND PRIVATE SECTOR. CLEARLY, WE NEED TO KNOW MORE AND A NATIONAL CLEARNINGHOUSE IS THE LOGICAL FIRST STEP IN EDUCATING OURSELVES ABOUT WHAT ALREADY IS HAPPENING.

STATES ARE MORE PRAGMATIC

IT SHOULD NOT BE SURPRISING THAT STATE AND LOCAL GOVERNMENTS ARE TAKING THE LEAD ON THE COMPETITIVENESS ISSUE. STATE AND LOCAL GOVERNMENTS HAVE INTIMATE KNOWLEDGE OF WHAT THE DECLINE IN COMPETITIVENESS MEANS TO THE WORKERS AND MANAGERS IN THEIR REGION.

THEY KNOW WHAT HAPPENS WHEN A FIRM CANNOT COMPETE IN THE INTERNATIONAL MARKETPLACE OR WHEN IT DETERMINES IT MUST RELOCATE ITS FIRM OVERSEAS TO TAKE ADVANTAGE OF LOWER WAGE COSTS. THEY CAN SEE BUSINESSES STRUGGLING TO ADJUST TO CHANGED MARKETS AND NEW TECHNOLOGY. THEY SEE ENTREPRENEURS WITH AN IDEA WHO CANNOT OBTAIN CAPITAL OR WHO NEED ASSISTANCE IN COMMERCIALIZING AN INVENTION.

STATE AND LOCAL GOVERNMENTS KNOW THAT UNDER THE CURRENT ADMINISTRATION AND WITH THE HUGE FEDERAL BUDGET DEFICITS, THEY CANNOT WAIT FOR WASHINGTON TO FORMULATE OR IMPLEMENT A COMPETITIVENESS STRATEGY FOR THE COUNTRY. THEY KNOW THAT THEIR ONLY ALTERNATIVE IS TO ACT ON THEIR OWN, USING THEIR OWN RESOURCES AND RELYING ON THEIR OWN GOOD JUDGEMENT ABOUT WHAT ROLE GOVERNMENT CAN PLAY.

STATE AND LOCAL GOVERNMENTS ARE IN MUCH HEALTHIER FISCAL SHAPE THAN IS THE FEDERAL GOVERNMENT. STATE AND LOCAL GOVERNMENTS TAKEN AS A WHOLE ARE RUNNING A BUDGET SURPLUS, WHICH CONTRASTS STARKLY WITH THE ABYSMAL DEFICITS WE ARE RUNNING AT THE FEDERAL LEVEL. BECAUSE OF THE IRRESPONSIBLE FISCAL POLICIES OF THIS ADMINISTRATION, AT THE FEDERAL LEVEL WE SIMPLY DO NOT HAVE THE FUNDS TO APPROPRIATE FOR NEW INITIATIVES, OR EVEN TO PROVIDE ADEQUATE FUNDING FOR EXISTING PROGRAMS IN THE AREAS OF EDUCATION, TRADE ADJUSTMENT ASSISTANCE, AND EXPORT PROMOTION. OUR NATIONAL ECONOMIC WELL-BEING IS THREATENED AND WE HAVE BEEN LEFT WITH INSUFFICIENT RESOURCES TO MAKE THE INVESTMENTS WHICH ARE NECESSARY TO MEEET THIS THREAT.

MOST IMPORTANT, STATE AND LOCAL GOVERNMENTS ARE FINDING THAT THEY CAN PLAY A CONSTRUCTIVE ROLE IN STIMULATING PRODUCTIVITY, TECHNOLOGY AND INNOVATION. THEY DO NOT HAVE A RIGID IDEOLOGICAL SUSPICION OF EVERYTHING THAT COMES FROM GOVERNMENT AS DOES THE ADMINISTRATION IN WASHINGTON. THEY'RE NOT CONCERNED ABOUT IDEOLOGICAL PURITY; THEY'RE JUST TRYING TO SOLVE PROBLEMS. THEY DON'T THROW AROUND SLOGANS ABOUT "GOVERNMENT BEING THE PROBLEM." THEY SEE A PROBLEM AND THEY GO TO WORK.

STATE AND LOCAL GOVERNMENTS ARE SENSITIVE TO WHAT GOVERNMENT CAN PROVIDE IN THE WAY OF ASSISTANCE AND THEY KNOW HOW GOVERNMENT INTRUSION CAN DO HARM. THEY CAN ADJUST PROGRAMS WHEN THEY FAIL OR WHEN THEY CAN BE IMPROVED. THEY SEEK FEEDBACK AND LISTEN BETTER THAN CAN ANY FEDERAL LEVEL PROGRAM.

STATE AND LOCAL GOVERNMENTS SEE THAT THE DISTINCTION BETWEEN PUBLIC AND PRIVATE INSTITUTIONS IS BECOMING BLURRED. THEY SEE THAT THE DISTINCTION IS NO LONGER AS GREAT BETWEEN PUBLIC EDUCATION INSTITUTIONS AND CORPORATE TRAINING PROGRAMS, BETWEEN TYPES OF FINANCIAL INSTITUTIONS OR COMMUNICATIONS TECHNOLOGIES, BETWEEN BASIC AND APPLIED RESEARCH, AND BETWEEN PHYSICS AND MATH.

WE NOW HAVE BOTH GOVERNMENTS AND BUSINESSES WHICH CONDUCT RESEARCH. WE HAVE PROFIT MAKING ORGANIZATIONS WHICH PERFORM IMPORTANT CHARITABLE SERVICES. WE HAVE CORPORATIONS WHICH PROVIDE HEALTH CARE AND HEALTH INSURANCE. WE HAVE BANKS WHICH SELL STOCKS. IT IS OUTDATED AND NAIVE TO ASSERT THAT THE PRIVATE SECTOR AND THE MARKETPLACE ARE THE SOLE PLAYERS IN ECONOMIC DEVELOPMENT.

STATE AND LOCAL GOVERNMENTS KNOW THAT IT IS SIMPLISTIC AND COUNTER-PRODUCTIVE TO ASSERT THAT GOVERNMENT "IS THE PROBLEM." GOVERNMENT CERTAINLY CAN CREATE PROBLEMS JUST AS CAN A PRIVATE BUSINESS WHEN IT IS POORLY MANAGED. WE AT THE FEDERAL LEVEL HAVE MADE MAJOR MISTAKES IN SETTING MACROECONMIC POLICY. BUT FOR GOOD OR BAD, GOVERNMENTS ARE HERE TO STAY AND THE ISSUE IS HOW WELL THEY ARE MANAGED AND HOW CONSTRUCTIVE THE ROLE IS THAT THEY PLAY. GOVERNMENT CAN BE A PARTNER OR A MEDDLER, BUT IT IS ALWAYS A FACTOR.

STATE AND LOCAL GOVERNMENTS ARE TAKING RISKS WITH THESE INNOVATIVE PROGRAMS. THEY ARE CONDUCTING EXPERIMENTS AND WE MUST UNDERSTAND THAT SOME OF THESE EXPERIMENTS WILL FAIL. SOME PUBLIC MONEY MAY NOT BE INVESTED WISELY IN SEARCHING FOR EFFECTIVE WAYS TO STIMULATE PRODUCTIVITY, TECHNOLOGY AND INNOVATION. SOME OF THESE PROGRAMS ALREADY ARE SUBJECT TO CONTROVERSY AND THERE IS ALWAYS CONTROVERSY WHEN TAXPAYERS' FUNDS ARE NOT INVESTED WITH A MAXIMUM RETURN. BUT, GOVERNMENT INSTITUTIONS NEED TO TAKE RISKS JUST AS DO CORPORATIONS. NEW PRODUCTS INTRODUCED INTO THE MARKETPLACE BY CORPORATIONS FAIL, INDEED MOST NEW PRODUCT INTRODUCTIONS FAIL. THIS DOESN'T LEAD CORPORATIONS TO STOP INTRODUCING NEW PRODUCTS. IF GOVERNMENT REFUSES TO TAKE RISKS AND REFUSES TO TRY INNOVATIVE APPROAHES TO PRESSING NATIONAL PROBLEMS, IT MAY WELL BECOME MORE OF THE PROBLEM THAN THE SOLUTION.

WE NEED TO EXPERIMENT WITH PARTNERSHIPS AND NEW RELATIONSHIPS BETWEEN THE PUBLIC AND PRIVATE SECTOR. WE NEED TO LEARN EVEN IF THAT SOMETIMES MEANS LEARNING FROM A MISTAKE.

WITH A NATIONAL CLEARINGHOUSE WE ALL CAN LEARN MORE FROM EXPERIMENTS WHICH OTHERS ALREADY ARE WILLING TO UNDERTAKE. THE CLEARINGHOUSE ITSELF IS ITSELF A MODEST EXPERIMENT GIVEN THE WILLINGNESS OF STATE AND LOCAL GOVERNMENTS TO FUND AND CONDUCT -- AND TAKE THE HEAT FOR -- EXPERIMENTS IN ENHANCING COMPETITIVENESS. IN SEEKING TO DETERMINE WHICH EXPERIMENTS ARE SUCCEEDING AND WHICH ARE NOT, HOPEFULLY WE CALL CAN AVOID REPEATEDLY MAKING THE SAME MISTAKES.

WITH RESPECT TO THE ROLE OF THE FEDERAL GOVERNMENT, MY LEGISLATION IS BASED ON THE PREMISE THAT THE FEDERAL GOVERNMENT CAN HAVE A SIGNIFICANT IMPACT IN PROMOTING THE COMPETITIVENESS OF OUR COUNTRY SIMPLY BY HELPING STATE AND LOCAL GOVERNMENTS TO CONTINUE THEIR EFFORTS AND TO LEARN FROM ONE ANOTHER. THIS IS A MINIMAL ROLE, BUT IT IS ONE THAT CAN PROVIDE US ALL WITH VITAL INFORMATION. WITHOUT THIS INFORMATION, WE AT THE FEDERAL LEVEL WILL CONTINUE TO FLOUNDER, CONTINUE TO ACT INDECISIVELY AND CONTINUE TO DEBATE THE ISSUE OF COMPETITIVENESS IN THE ABSTRACT.

WITH A CLEARINGHOUSE WE ARE ACKNOWLEDGING THAT THE FEDERAL GOVERNMENT IS NOT THE ONLY, AND INDEED IT IS NOT EVEN THE MAJOR, ACTOR IN ENHANCING THE COMPETITIVENESS OF OUR BUSINESS SECTOR. THERE ARE FIFTY STATE GOVERNMENTS, THOUSANDS OF CITY AND COUNTRY GOVERNMENTS, THOUSANDS OF UNIVERSITIES, THOUSANDS OF FOUNDATIONS, THOUSANDS OF NON-PROFIT INSTITUTIONS, AND THOUSANDS OF PRIVATE CORPORATIONS WHICH CAN TAKE THE LEAD. WE NEED ALL OF THEM TO PLAY A CONSTRUCTIVE ROLE AND WE AT THE FEDERAL LEVEL NEED TO DO ALL THAT WE CAN TO STIMULATE DIVERSE APPROACHES TO THE COMPETITIVENESS CHALLENGE.

IT WOULD BE FOLLY AND UNWISE TO PURSUE ONE SINGLE, NATIONAL, AND FEDERALLY-MANDATED STRATEGY.

NEED FOR A CLEARINGHOUSE

S. 930 WOULD CREATE A CENTER ON STATE AND LOCAL INITIATIVES ON PRODUCTIVITY, TECHNOLOGY AND INNOVATION. THE CENTER WOULD BE LOCATED IN THE COMMERCE DEPARTMENT AND ITS PRINCIPAL FUNCTION IS TO SERVE AS A CLEARINGHOUSE ON THE COMPETITIVENESS INITIATIVES OF STATE AND LOCAL GOVERNMENTS, REGIONAL ORGANIZATIONS, UNIVERSITY AND PRIVATE SECTOR COOPERATION, AND JOINT PUBLIC-PRIVATE SECTOR PARTNERSHIPS.

THE PRESIDENT'S COMMISSION ON INDUSTRIAL COMPETITIVENESS STUDIED THE EFFORTS OF STATE AND LOCAL GOVERNMENTS TO BOOST COMPETITIVENESS. IN A REPORT TO THE COMMISSION PREPARED FOR THE TASK FORCE ON STATE AND LOCAL INITIATIVES BY SRI INTERNATIONAL AND THE CHEMICAL BANK, IT IS RECOMMENDED THAT "A NATIONAL RESOURCE CENTER SHOULD BE ESTABLISHED TO IDENTIFY STATE INNOVATIONS, ASSESS THEIR EFFECTIVENESS AND PROMOTE ACTION BY STATES AND INDUSTRY." ("INNOVATIONS IN INDUSTRIAL COMPETITIVENESS AT THE STATE LEVEL," REPORT TO THE PRESIDENT'S COMMISSION, SRI INTERNATIONAL, DECEMBER 1984, AT 70.)

THIS REPORT FOUND THAT "STATES, INDUSTRY, AND THE FEDERAL GOVERNMENT ALL NEED BETTER INFORMATION ON WHICH OF THE STRATEGIES ATTEMPTING TO PROMOTE INDUSTRIAL COMPETITIVENESS AT THE STATE LEVEL ARE WORKING." (REPORT AT 70.) IT FOUND THAT ONLY A "LIMITED AMOUNT OF SYSTEMATIC EFFORT" HAD BEEN MADE TO "DOCUMENT AND ASSESS WHAT HAS

BEEN HAPPENING." (ID.) THE RECOMMENDED "NATIONAL RESOURCE CENTER" COULD "SERVE AS A NATIONAL CLEARINGHOUSE, A NEUTRAL FORUM FOR DISCUSSIONS AMONG SECTORS AND A RESOURCE FOR TECHNICAL ASSISTANCE FOR STATES OR INDUSTRY INTERESTED IN DEVELOPING NEW STRATEGIES." (ID.)

SIMILARLY, THE CONGRESSIONAL OFFICE OF TECHNOLOGY ASSESSMENT FOUND THAT TO PROVIDE DIRECT OR INDIRECT ASSISTANCE TO STATE OR REGIONAL HIGH TECHNOLOGY DEVELOPMENT, IT WOULD BE HELPFUL FOR THE FEDERAL GOVERNMENT TO ESTABLISH AN INFORMATION CLEARINGHOUSE "CONTAINING A COMPREHENSIVE AND UP-TO-DATE LIST OF STATE AND LOCAL INITIATIVES" THAT SUPPORT HIGH TECHNOLOGY DEVELOPMENT. ("TECHNOLOGY, INNOVATION, AND REGIONAL ECONOMIC DEVELOPMENT," OFFICE OF TECHNOLOGY ASSESSMENT, JULY 1984, AT 11.) THE REPORT FOUND THAT THE MOST HELPFUL TYPE OF INFORMATION THE CLEARINGHOUSE COULD ASSEMBLE WOULD BE A "PROJECT BANK" SUCH AS THAT ESTABLISHED BY THE WHITE HOUSE TASK FORCE ON PRIVATE SECTOR INITIATIVES.

WITH THE INFORMATION WHICH A CLEARINGHOUSE CAN ASSEMBLE, WE IN CONGRESS AND THE EXECUTIVE BRANCH CAN DETERMINE TO WHAT EXTENT THIS RECOMMENDATION HAS VALIDITY. WE CERTAINLY NEED TO KNOW MUCH MORE ABOUT THE INITIATIVES OF STATE AND LOCAL GOVERNMENTS BEFORE THE THE FEDERAL GOVERNMENT SHOULD LEND ITS FINANCIAL RESOURCES TO THESE STATE INITIATIVES OR ORGANIZE SIMILAR INITIATIVES AT THE FEDERAL LEVEL.
THE CENTER IS NOT AUTHORIZED TO PROVIDE FINANCIAL ASSITANCE TO THE STATE AND LOCAL GOVERNMENT AGENCIES TO FUND THE INITIATIVES WHICH ARE
((2)) BEING UNDERTAKEN. (SECTION 5A (I)(1)(A).)

ON THE ISSUE OF UNDERWRITING THE COST OF THE COMPETITIVENESS INITIATIVES, S. 930 DOES NOT GIVE THE CLEARINGHOUSE AUTHORIZATION TO PROVIDE FUNDING TO THE STATE AND LOCAL GOVERNMENT AGENCIES. THERE ARE SEVERAL REASONS FOR THIS:

(1). THE BUDGET DEFICITS DO NOT NOW PERMIT THE FEDERAL GOVERNMENT TO UNDERTAKE A SIGNIFICANT FUNDING PROGRAM.

(2). IF WE GAVE THE CLEARINGHOUSE LIMITED FUNDS TO UNDERWRITE STATE AND LOCAL INITIATIVES, THE CLEARINGHOUSE WOULD HAVE TO BE VERY SELECTIVE IN WHICH INITIATIVES RECEIVED FUNDING.

(3). WHEN THE CLEARINGHOUSE CAN ONLY FUND A FEW INITIATIVES, IT WILL HAVE TO IMPOSE ITS OWN PRIORITIES AND ITS OWN BIASES ON THE STATE AND LOCAL GOVERNMENTS.

(4). WE DO NOT WANT TO DO ANYTHING TO STIFLE THE CREATIVITY AND EXPERIMENTATION WE HAVE SEEN AT THE STATE AND LOCAL LEVEL IN UNDERTAKING THESE INITIATIVES.

(5). ONE INNOVATION WHICH WE ARE SEEING AT THE STATE AND LOCAL LEVEL IS IN HOW THEY FUND THEIR INITIATIVES. PRIVATE FUNDS, FOUNDATION FUNDS, PUBLIC EMPLOYEE PENSION FUNDS AND UNIVERSITY FUNDS ARE OFTEN INVOLVED. WE DO NOT WANT TO UNDERMINE THIS TYPE OF INNOVATION BY PROVIDING FEDERAL FUNDING.

FEDERAL GOVERNMENT REGULATIONS. THE CLEARINGHOUSE IS A FACILITATOR, NOT AN DOMINANTING FORCE.

FEDERAL GOVERNMENT HAS MUCH TO LEARN

I ALSO WANT THE FEDERAL GOVERNMENT ITSELF TO LEARN FROM THE EXPERIENCE OF STATE AND LOCAL GOVERNMENTS. IN FACT, THE FEDERAL GOVERNMENT ITSELF COULD BE ONE OF THE PRINCIPAL BENEFICIARIES OF THE EFFORTS OF THE CENTER, ALONG WITH THE STATE AND LOCAL GOVERNMENTS WHICH CAN LEARN FROM ONE ANOTHER.

IT IS IMPORTANT FOR THE FEDERAL GOVERNMENT TO EXAMINE WHAT THE STATE AND LOCAL GOVERNMENTS ARE DOING BECAUSE THE FEDERAL GOVERNMENT IS STRUGGLING TO DECIDE WHAT IT CAN DO ABOUT THE COMPETITIVENESS PROBLEM. WE NEED TO ACT, BUT WE NEED TO ACT WISELY. THE POWER OF THE FEDERAL GOVERNMENT CAN BE USED CREATIVELY AND CONSTRUCTIVELY, BUT IT CAN DO HARM AS WELL.

I BELIEVE THAT THE CLEARINGHOUSE WILL FIND THAT STATE AND LOCAL GOVERNMENTS ARE DEVELOPING EFFECTIVE AND COST EFFECTIVE WAYS TO TARGET THEIR EFFORTS TO ENHANCE COMPETITIVENESS. IF THE CLEARINGHOUSE FINDS THIS TO BE TRUE, THESE LESSONS CAN BE APPLIED AT THE FEDERAL LEVEL AND THEY WILL BE OF IMPORTANCE FOR US HERE IN CONGRESS AS WE EXAMINE PROPOSED INITIATIVES FOR THE FEDERAL GOVERNMENT.

WE MAY FIND THAT THERE ARE SOME AREAS WHERE NEW PROGRAMS AT THE FEDERAL LEVEL ARE CLEARLY APPROPRIATE. WE MAY FIND THAT THE

PRINCIPAL NEED IS FOR ADDITIONAL RESOURCES TO BE PUT INTO THE MOST SUCCESSFUL EXISTING PROGRAMS, PARTICULARLY IN THE AREA OF EDUCATION, IN FUNDING BASIC RESEARCH, AND IN RESPONDING TO UNFAIR TRADE PRACTICES OF FOREIGN COMPETITORS. OR WE MAY FIND THAT WHOLLY NEW APPROACHES ARE NEEDED. FUNDING FOR SOME PROGRAMS MAY BE BETTER SPENT ON OTHER EFFORTS OR NOT SPENT AT ALL.

IF THE FEDERAL GOVERNMENT UNDERTAKES NEW INITIATIVES TO ENHANCE COMPETITIVENESS, IT IS IMPORTANT THAT THESE INITIATIVES BE WELL CONCEIVED. WE DO NOT HAVE TO REINVENT THE WHEEL AT THE FEDERAL LEVEL. BUT, JUST AS IMPORTANT, WE NEED TO KNOW HOW ANY FEDERAL PROGRAM RELATES TO EXISTING PROGRAMS AT THE STATE AND LOCAL LEVEL. WE NEED TO ENSURE THAT THE FEDERAL GOVENRMENT DOES NOT TRAMPLE ON THE EFFORTS OF OTHER LEVELS OF GOVERNMENT.

WITH THIS CLEARINGHOUSE WE IN WASHINGTON MAY DISCOVER NEW WAYS IN WHICH THE FEDERAL GOVERNMENT CAN BECOME MORE HELPFUL THAN IT IS NOW. WE CERTAINLY CAN LEARN FROM AND AVOID THE MISTAKES MADE BY STATE AND LOCAL GOVERNMENTS.

WITH A CLEARINGHOUSE, THE FEDERAL GOVERNMENT MAY CONCLUDE THAT THE MOST CONSTRUCTIVE ROLE IT CAN PLAY IS TO PROVIDE DIRECT SUPPORT TO STATE AND LOCAL GOVERNMENTS TO CONTINUE THEIR EXPERIMENTS. CERTAIN FUNCTIONS MAY MOST APPROPRIATELY BE HANDLED AT THE LOCAL LEVEL WITH A MINIMUM OF FEDERAL GOVERNMENT INVOLVEMENT, SUPERVISION OR FUNDING. INDEED, THE REPORT TO THE COMPETITIVENESS COMMISSION RECOMMENDED THAT "WHERE THE FEDERAL GOVERNMENT DOES ACT TO PROMOTE INDUSTRIAL COMPETITIVENESS, IT SHOULD USE STATE GOVERNMENT WHEREVER

POSSIBLE AS THE MEANS FOR IMPLEMENTING ITS OBJECTIVES." (REPORT AT 69.)

IT MAY WELL BE THAT IN MANY WAYS FEDERAL GOVERNMENT INTRUSION WILL HAMPER THE CREATIVITY AND EFFECTIVENESS OF STATE AND LOCAL INITIATIVES. THERE IS A GREAT VIRTUE IN HAVING FIFTY STATES EXPERIMENTING WITH PROGRAMS AND WE SHOULD MAKE SURE THAT THIS DIVERSITY IS ENCOURAGED.

IT MAY BE THAT THERE ARE APPROACHES TO NATIONAL PROBLEMS WHICH CAN ONLY BE EFFECTIVELY ADDRESSED BY REGIONAL APPROACHES OR BY COORDINATED EFFORTS AMONG SEVERAL REGIONS OF THE COUNTRY. SOMETIMES IT MAKES NO SENSE TO STATES TO DUPLICATE THE EFFORTS OF SISTER STATES. IT CERTAINLY MAKES NO SENSE FOR THE FEDERAL GOVERNMENT TO PROVIDE SERVICES WHICH DUPLICATE THOSE ALREADY BEING PROVIDED BY STATE AND LOCAL GOVERNMENT AGENCIES.

IT MAY BE THAT THE EXPERIENCE OF STATE AND LOCAL GOVERNMENTS WILL GIVE US MORE CONFIDENCE, OR LESS CONFIDENCE, THAT SOME SORT OF NATIONAL DEVELOPMENT BANK MIGHT BE EFFECTIVE.

OR A CONCENSUS MAY DEVELOP THAT THERE ARE NEW INITIATIVES SHORT OF A DEVELOPMENT BANK WHICH ARE BEST HANDLED DIRECTLY BY THE FEDERAL GOVERNMENT WITH ITS GREATER RESOURCES AND NATIONAL FOCUS.

I AM OPEN TO LEARNING FROM THE CLEARINGHOUSE. LIKE ALL OF MY COLLEAGUES, I BELIEVE WE HAVE A CRUCIAL PROBLEM WITH COMPETITIVENESS AND WANT TO TAKE ACTION TO ADDRESS THIS PROBLEM. BUT, I AM RELUCTANT

TO SUPPORT UNTRIED, UNTESTED FEDERAL PROGRAMS, PARTICULARLY IF THEY IMPEDE OUR ABILITY TO CONTROL THE BUDGET DEFICIT. THE BUDGET DEFICIT IS THE ROOT OF MUCH OF THE MALAISE IN OUR ECONOMY.

ESTABLISHING A CLEARINGHOUSE WILL HELP ME TO HAVE CONFIDENCE THAT THE FEDERAL GOVERNMENT KNOWS WHAT IT SHOULD AND CAN DO AND WILL AVOID MAKING THE PROBLEM WORSE.

ALL OF US AT THE FEDERAL GOVERNMENT LEVEL CAN BENEFIT BY LEARNING WHAT THE STATE AND LOCAL GOVERNMENTS ARE TRYING, TO EVALUATE THESE INITIATIVES, AND TO COORDINATE EXISTING FEDERAL GOVERNMENT RESOURCES IN A WAY THAT COMPLEMENTS THESE INITIATIVES.

PRIORITIES FOR THE CLEARINGHOUSE

WHILE THERE IS AS YET NO FORMAL OR INFORMAL CLEARINGHOUSE ON STATE AND LOCAL GOVERNMENT INITIATIVES ON COMPETITIVENESS, A NUMBER OF SURVEYS HAVE BEEN CONDUCTED TO DOCUMENT THESE INITIATIVES. THESE SURVEYS SHOW THAT STATE AND LOCAL GOVERNMENTS ARE ENGAGED IN AN IMPRESSIVE ARRAY OF PROGRAMS. SOME OF THESE INITIATIVES ARE BOLD EXPERIMENTS AND OTHERS ARE MORE TRADITIONAL EFFORTS FOCUSING ON ECONOMIC DEVELOPMENT. THE CLEARINGHOUSE MUST SET ITS PRIORITIES CAREFULLY TO MAXIMIZE ITS EFFECTIVENESS.

THE CLEARINGHOUSE I HAVE PROPOSED IS DIRECTED TO FOCUS ON THE BOLDEST AND MOST INTERESTING INITIATIVES WHICH STIMULATE PRODUCTIVITY, TECHNOLOGY AND INNOVATION. IT IS BARRED FROM INVOLVEMENT WITH THOSE INITIATIVES WHICH INVOLVE ECONOMIC INCENTIVES

FOR A FIRM TO LOCATE OR RELOCATE FACILITIES IN THAT STATE OR LOCAL COMMUNITY, INITIATIVES WHICH HAVE NO DIRECT INTEREST TO OTHER STATES (OTHER THAN FOR THOSE IN COMPETITION FOR THE FACILITY). BUT, IN BETWEEN THESE TWO EXTREMES, THE CENTER WILL HAVE TO EVALUATE THE PURPOSE AND EFFECT OF AN INITIATIVE TO DETERMINE WHETHER THE INITIATIVE IS OF INTEREST TO OTHER STATES AND TO THE FEDERAL GOVERNMENT.

THE BILL CONTAINS A DESCRIPTION OF THE TYPES OF INITIATIVES THE CENTER SHOULD FOCUS ON, BUT THIS LIST IS NOT AN EXCLUSIVE ONE. THE LIST INCLUDES INITIATIVES WHICH "STIMULATE THE FORMATION OF NEW SMALL BUSINESSES," "CREATE A FAVORABLE CLIMATE FOR ENTREPRENEURS," "INVOLVE COOPEATION AMONG GOVERNMENT AGENCIES, REGIONAL ORGANIZATIONS, BUSINESS, LABOR ORGANIZATIONS, AND NON-PROFIT INSITUTIONS," "FOSTER COOPERATION BETWEEN LABOR AND MANAGEMENT," "GENERATE VENTURE CAPITAL," "ORGANIZE PARTNERSHIPS AMONG BUSINESS AND EDUCATION INSTITUTIONS," "EXPEDITE THE TRANSFER OF TECHNOLOGY," "PROVIDE TRAINING IN ENTREPRENEURSHIP," AND ENCOURAGE "THE ESTABLISHMENT OF FLEXIBLE, COMPUTER-INTEGRATED MANUFACTURING SYSTEMS." (SECTION 5A (H).) THERE UNDOUBTEDLY ARE MANY OTHER AREAS WHICH THE CENTER SHOULD STUDY. INDEED, THE CREATIVITY OF STATE AND LOCAL GOVERNMENTS WILL CONTINUALLY CHALLENGE THE DIRECTOR AND THE CENTER WITH NEW INITIATIVES.

IT IS NOT ALWAYS POSSIBLE CLEARLY TO DISTINGUISH BETWEEN THESE INITIATIVES WHICH ADVANCE THE STATE OF KNOWLEDGE ABOUT HOW TO BE MORE COMPETITIVE AND THOSE WHICH SIMPLY PROVIDE ADDITIONAL ECONOMIC RESOURCES TO A PARTICULAR FIRM. THIS WILL PRESENT A SPECIAL

CHALLENTE TO THE DIRECTOR AND THE CENTER IN SETTING PRIORITIES. THE INITIATIVES OF STATE AND LOCAL GOVERNMENTS RANGE OVER A CONTINUUM FROM PARTNERSHIPS IN BASIC RESEARCH ON THE MANUFACTURING PROCESS TO SPECIAL INTEREST TAX BREAKS TO INDUCE A FIRM TO CHOOSE ONE SITE OVER ANOTHER IN A FIERCE COMPETITION AMONG TWO TOWNS IN A COUNTY.

COMPETITION AMONG THE STATES

WE ALL KNOW THAT STATES AND LOCAL COMMUNITIES COMPETE AMONG THEMSELVES TO ENTICE FIRMS TO LOCATE OR RELOCATE THEIR PLANTS AND HEADQUARTERS. IN THIS COMPETITION, ONE TOWN MAY OFFER TAX INCENTIVES, IT MAY UPGRADE THE LOCAL INFRASTRUCTURE OR IT MAY LEASE AVAILABLE LAND AT A BELOW-MARKET RATE.

WE ARE ALL AWARE, FOR EXAMPLE, OF THE COMPETITION WHICH OCCURRED WHEN GENERAL MOTORS WAS SHOPPING AROUND FOR A LOCATION FOR ITS NEW AUTOMOBILE PRODUCTION FACILITY, AND THE SAME HAS BEEN TRUE WHEN JAPANESE AUTOMOBILE FIRMS HAVE BEEN CONSIDERING LOCATIONS FOR U.S.-BASED MANUFACTURING FACILITIES.

OBVIOUSLY, THIS TYPE OF COMPETITION HAS AN IMPACT ON THE ECONOMICS OF THE FIRMS WHICH BENEFIT FROM THESE INCENTIVES. TAX BREAKS, IMPROVED INFRASTRUCTURE AND BELOW-MARKET RATE LEASES WILL LOWER THE FIRM'S COSTS AND THAT IMPROVES THE FIRM'S PRODUCTIVITY.

BUT, THIS TYPE OF GOVERNMENT ASSISTANCE IS MORE LIKE A GOVERNMENT GRANT THAN A BOLD EXPERIMENT. IT IS NOT DIRECTED AT CHANGING THE MANAGEMENT APPROACH OF THE FIRM, THE MANUFACTURING

PROCESS, OR THE EMPLOYEE TRAINING AT THE FIRM. IT IS NOT DIRECTED AT STIMULATING THE DEVELOPMENT OF NEW TECHNOLOGY OR THE CREATIVITY OF THE FIRM'S SCIENTISTS. IT DOES NOT ENCOURAGE BASIC OR APPLIED RESEARCH BY THE FIRM OR INVESTMENTS IN NEW EQUIPMENT. AND, AS A RESULT, IT SHOULD BE OF MUCH LESS INTEREST TO THE CENTER.

LET ME BE CLEAR. THE ECONOMIC DEVELOPMENT EFFORTS OF STATE AND LOCAL GOVERNMENTS ARE VALUABLE AND IMPORTANT. THEY LEAD TO ECONOMIC GROWTH AND INCREASED EMPLOYMENT, BUT IN MANY CASES THE RESULT OF THESE EFFORTS IS MORE TO SHIFT THE GROWTH AND EMPLOYMENT FROM ONE CITY OR TOWN TO ANOTHER, NOT TO STIMULATE A NET INCREASE IN THE NATION'S GROWTH OR EMPLOYMENT. THESE EFFORTS MAY AMOUNT TO A ZERO SUM GAME FOR THE NATION'S ECONOMY EVENTHOUGH THEY PROVIDE VALUABLE BENEFITS TO INDIVIDUAL BUSINESSES.

IT IS NOT CLEAR THAT THE COMPETITION AMONG THE STATES ALWAYS IS HEALTHY OR FAIR. IT IS CERTAINLY DIFFICULT FOR A RURAL OR ECONOMICALLY DISADVANTAGED COMMUNITY TO COMPETE WITH A RELATIVELY WELL-TO-DO TOWN. OFTEN THE RICH GET RICHER AND THE POOR GET POORER IN THIS COMPETITION. POOR STATES ARE FORCED TO COMPETE BY OFFERING MORE SPECIAL TAX BREAKS OR OTHER INCENTIVES, WHICH THEY CAN ILL AFFORD TO PROVIDE. ONE RECENT STUDY BY CORPORATION FOR ENTERPRISE DEVELOPMENT FOUND THAT "MANY SUN BELT STATES THAT CUT TAXES AND SERVICES TO ATTRACT INDUSTRY ARE PAYING THE PRICE WITH LACKLUSTER ECONOMIES..." ("STUDY FINDS SUN BELT SUFFERS FROM STEPS TO DRAW INDUSTRY," WASHINGTON POST, MARCH 19, 1987).

THIS COMPETITION AMONG STATE AND LOCAL JURISDICTIONS, HOWEVER, IS A FIXTURE IN OUR MARKET ECONOMY. STATES ARE PART OF THAT MARKET AND THE FEDERAL GOVERNMENT SHOULD NOT ATTEMPT TO ARBITRATE THIS COMPETITION. IT CERTAINLY HAS NO WAY TO PREVENT IT. AT BEST WE CAN TRY TO SHIFT THIS COMPETITION TO MORE CONSTRUCTIVE APPROACHES, APPROACHES WHICH STIMULATE PRODUCTIVITY OF FIRMS WHICH ALREADY ARE LOCATED IN THE AREA OR WHICH STIMULATE THE CREATION OF NEW FIRMS THERE AND THE CENTER MAY HELP IN THIS RESPECT TO REDUCE THE TYPE OF COMPETITION AMONG THE STATES WHICH HAS NOT PROVEN TO BE CONSTRUCTIVE.

TO ENSURE THAT THE CENTER DOES NOT BECOME ENBROILED IN THE INTENSE COMPETITION AMONG STATE AND LOCAL GOVERNMENTS, THE CLEARINGHOUSE I PROPOSE IS SPECIFICALLY PROHIBITED FROM ASSISTING ONE STATE OR LOCAL GOVERNMENT IN ENCOURAGING A PRIVATE BUSINESS TO RELOCATE ANY FACILITY FROM ONE STATE OR LOCAL JURISDICTION TO ANOTHER OR TO LOCATE ANY NEW FACILITY IN ONE STATE OR LOCAL JURISDICTION RATHER THAN ANOTHER. (SECTION 5A. (I)(1)(C).) THE FEDERAL GOVERNMENT HAS NO LEGITIMATE ROLE TO PLAY IN FAVORING ONE STATE OVER ANOTHER WHEN A PRIVATE FIRM IS DETERMINING WHETHER OR NOT TO RELOCATE OR WHERE TO RELOCATE. THE CENTER COULD NEVER ESTABLISH A RELATIONSHIP OF CONFIDENCE WITH STATE AND LOCAL GOVERNEMENTS IF IT BECAME A PARTISAN IN DISPUTES AMONG THE STATES.

SIMILARLY, THE BILL WOULD BAR THE CENTER FROM PROVIDING ANY FINANCIAL ASSISTANCE TO SUPPORT A STATE AND LOCAL GOVERNMENT TO STIMULATE ECONOMIC DEVELOPMENT THROUGH THE CONDUCT OF PUBLIC WORKS OR THE REPAIR OR REPLACEMENT OF INFRASTRUCTURE. (SECTION 5A.(I)(1)(B).) AGAIN, THESE ACTIVITIES ARE IMPORTANT FUNCTIONS OF GOVERNMENT AND

PRIVATE BUSINESSES NEED THE ASSISTANCE OF GOVERNMENT ON THESE INITIATIVES. BUT, THESE INITIATIVES ARE ROUTINE FUNCTIONS OF GOVERNMENT, NOT BOLD EXPERIMENTS OF INTEREST TO THE FEDERAL GOVERNMENT AND OTHER STATE AND LOCAL GOVERNMENTS.

SIMILARLY, THE CENTER IS BARRED FROM PROVIDING DIRECT FINANCIAL ASSISTANCE TO FUND STATE AND LOCAL DEVELOPMENT INITIATIVES. (SECTIN 5A.(I)(1)(A).) FUNDING FOR THESE INITIATIVES MIGHT WELL BE AVAILABLE FROM OTHER FEDERAL AGENCIES AND THE CENTER MAY PEFORM A SERVICE BY COMPILING INVENTORIES ON FEDERAL FUNDS WHICH MIGHT BE AVAILABLE. BUT, THE CENTER MUST NOT BECOME INVOLVED IN PROVIDING THE FUNDING ITSELF OR INTERVENING AS A PARTISAN IN THE COMPETITION FOR SCARCE FEDERAL RESOURCES.

FINALLY, THE CENTER IS BARRED FROM CONSIDERING ANY ISSUED "INCLUDED IN A SPECIFIC LABOR-MANAGEMENT AGREEMENT WITHOUT THE CONSENT AND COOPERATION OF ALL PARTIES TO THE AGREEMENT." (SECTION 5A (I)(1)(D).) THIS PROHIBITION HAS A SIMILAR INTENT TO THOSE JUST DESCRIBED. THE CENTER SHOULD NOT SERVE AS AN ARBITRATOR OF DISPUTES. IT SHOULD PROVIDE INFORMATION AND MONITOR DEVELOPMENTS. ONCE IT BECOMES A PLAYER IN THESE DISPUTES, IT WILL LOSE CREDIBILITY WITH ANY PARTIES WITH AN ADVERSE ECONOMIC OR POLITICAL INTEREST.

STATE INITIATIVES OF NATIONAL INTEREST

THE PURPOSE OF THE CLEARINGHOUSE IS TO FOCUS ON STATE AND LOCAL INITIATES WHICH PROVIDE A BENEFIT TO THE NATION AS A WHOLE, WHICH STIMULATE PRODUCTIVITY FOR AN ENTIRE INDUSTRY, WHICH DEVELOP A NEW

TECHNOLOGY WHICH CREATES A NEW INDUSTRY, AND WHICH LEAD TO NEW DISCOVERIES ABOUT MATERIALS, PRODUCTS OR PROCESSES. IT IS THESE INITIATIVES WHICH ARE OF GREATEST INTEREST TO OTHER STATE AND LOCAL GOVERNMENTS AND TO THE FEDERAL GOVERNMENT.

IT IS RELATIVELY EASY FOR A STATE OR LOCAL GOVERNMENT TO BUILD A NEW ROAD TO SERVICE A NEW FACTORY. HOWEVER, STATE AND LOCAL GOVERNMENT INITIATIVES WHICH TARGET PRODUCTIVITY, TECHNOLOGY AND INNOVATION REQUIRE MUCH MORE SOPHISTICATION. THESE INITIATIVES ARE MUCH MORE DIFFICULT TO FASHION AND THEY ARE MUCH MORE CONTROVERSIAL. THE SUCCESS OF THESE INITIATIVES IS MUCH HARDER TO MEASURE. INITIATIVES OF THIS TYPE ARE EXPERIMENTS. WHEN THEY SUCCEED, HOWEVER, THESE INITIATIVES ARE THE ONES WHICH ARE THE MOST SIGNIFICANT IN OUR EFFORT TO ENHANCE THE COMPETITIVENESS OF THE NATION AS A WHOLE.

THE LESSONS ABOUT PRODUCTIVITY WHICH ARE LEARNED BY A FIRM IN ONE STATE OR CITY CAN BE HELPFUL TO A FIRM IN ANOTHER STATE OR CITY. ONE CANNOT PICK UP A NEW ROAD AND TRANSFER IT SOMEWHERE ELSE, BUT WE CAN EASILY TRANSPORT AN IDEA, A NEW PROCESS, OR A NEW MATERIAL FROM ONE STATE TO ANOTHER.

UNDER MY LEGISLATION, THE CLEARINGHOUSE IS DIRECTED TO FOCUS ITS EFFORTS ON THOSE INITIATIVES WHICH ARE DIRECTED AT ENHANCING PRODUCTIVITY, TECHNOLOGY AND INNOVATION. IT IS THESE INITIATIVES WHICH ARE MOST IMPORTANT TO THE NATION AS A WHOLE AND IT IS THESE INITIATIVES WHICH ARE OF GREATEST VALUE TO THE EFFORTS OF THE OTHER STATES. THERE IS GREAT VALUE IN LEARNING ABOUT HOW FIRMS INCREASE

PRODUCTIVITY, HOW THEY DEVELOP TECHNOLOGY AND HOW THEY ENHANCE THE INVENTIVENESS OF A FIRM'S EMPLOYEES.

COMPETITION FOR PRODUCTIVITY

WHAT WE WANT TO ENCOURAGE IS COMPETITION AMONG THE STATES TO INCREASE THE PRODUCTIVITY OF THE FIRMS IN THEIR AREA, NOT TO COMPETE WITH OTHER STATES IN OFFERING ECONOMIC INCENTIVES TO FIRMS TO RELOCATE. WHEN STATES UNDERTAKE EXPERIMENTS IN GOVERNMENT-PRIVATE PARTNERSHIPS, THEY MAY DO SO PARTLY TO COMPETE WITH OTHER STATES WHICH HAVE LAUNCHED SIMILAR PROGRAMS. BUT, THIS TYPE OF COMPETITION IS HEALTHY; IT'S PRECISELY THE TYPE OF COMPETITION WE WANT TO ENCOURAGE.

INDEED, IF WE FIND THAT STATE AND LOCAL GOVERNMENTS CAN HELP TO STIMULATE PRODUCTIVITY OF THE FIRMS ALREADY LOCATED IN THEIR AREA, THEY MAY FIND IT MUCH LESS NECESSARY TO ENTICE OTHER FIRMS TO CHOOSE THEIR TOWN AS THE LOCATION FOR A NEW FACILITY. THE CENTER CAN HELP THE STATES FIND OTHER BASIS FOR COMPETITON THAN FORGOING THE COLLECTION OF TAXES OR PROVIDING SPECIAL AND COSTLY SERVICES THAT ARE NOT NORMALLY AVAILABLE. IF STATES HAVE NO WAYS TO COMPETE OTHER THAN WAYS THAT MAY BE SHORT-SIGHTED, THEY MAY NONETHELESS FEEL COMPELLED TO COMPETE.

SOME ARGUE THAT THE STATE AND LOCAL GOVERNMENTS NEED TO BE SAVED FROM THEMSELVES IN THIS COMPETITON. PROPOSALS HAVE BEEN CIRCULATED THAT THE STATES AGREE AMONG THEMSELVES TO COMPETE IN A MORE POSITIVE, LESS SELF-DESTRUCTIVE WAY. SUCH AN AGREEMENT MIGHT

TAKE THE FORM OF A "DISARMAMENT" TREATY IN WHICH STATES AGREE, FOR EXAMPLE, NOT TO PROVIDE SPECIAL REDUCTIONS IN PROPERTY OR OTHER TAXES TO ENTICE FIRMS TO LOCATE OR RELOCATE THEIR FACILITIES IN A STATE. BUT, UNTIL STATE AND LOCAL GOVERNMENTS VOLUNTARILY LIMIT THE COMPETITION AMONG THEMSELVES, THE BEST WE CAN DO MAY BE TO ENCOURAGE COMPETITION ON THE BASIS OF CONSTRUCTIVE PARTNERSHIPS IN ENHANCING PRODUCTIVITY, TECHNOLOGY AND INNOVATION.

MANY OBSERVERS HAVE ARGUED THAT STATES WILL DO BETTER IN ECONOMIC DEVELOPMENT IF THEY CONCENTRATE ON STIMULATING THE ESTABLISHMENT OF SMALL BUSINESSES RATHER THAN ON ATTRACTING LARGE FIRMS AND THEIR SUBSIDIARIES TO THE STATE. THE NATIONAL GOVERNORS ASSOCIATION HAS SAID IN A REPORT ON THIS ISSUE THAT

> "MOST STATES ARE WELL AWARE OF THE LIMITATIONS IMPOSED ON SHORT-TERM STRATEGIES AIMED AT RECRUITING TECHNOLOGY-BASED INDUSTRIAL FIRMS...NOT ONLY ARE THERE BUT A FINITE NUMBER OF FIRMS TO COMPETE FOR, BUT ALSO THE COMPETITION ITSELF IS SEVER (AND) NO SINGLE STATE CAN HOPE TO CAPTURE A SIGNIFICANT NUMBER OF THESE FIRMS...IN THE LONG RUN...THE KEY TO CONTINUED ECONOMIC GROWTH AND TO THE CREATION OF NEW, MORE MEANINGFUL JOBS FOR WORKERS AT ALL SKILL AND AGE LEVELS LIES WITH (L) DEVELOPING STRATEGIES GEARED TO CREATING THE RIGHT ENVIRONMENT FOR TECHNOLOGICAL INNOVATION; (2) ASSISTING INVENTORS AND ENTREPRENEURS IN NEW BUSINESS FORMATION; AND (3) IN HELPING EXISTING FIRMS TO EXPAND AND PROSPER."

THE CENTER CAN HELP THE STATE AND LOCAL GOVERNMENTS TAKE POSITIVE STEPS ON EACH OF THESE POINTS AND, THEREIN, HELP TO REDUCE WASTEFUL COMPETITION AMONG THEM.

RANGE OF STATE AND LOCAL INITIATIVES

THE RANGE OF STATE AND LOCAL INITIATIVES TO STIMULATE PRODUCTIVITY, TECHNOLOGY AND INNOVATION IS BROAD AND GROWING. WITH ALL FIFTY STATES INTERESTED IN THE ISSUE, MANY NOVEL PROGRAMS HAVE BEEN LAUNCHED AND EVEN MORE ARE BEING CONSIDERED. THE ABSENCE OF FEDERAL GOVERNMENT INTEREST HAS CHALLENGED STATE AND LOCAL GOVERNMENTS TO FILL THE VOID AND THEY HAVE DONE SO WITH LITTLE HESITATION.

THERE ARE PROGRAMS WHERE THE STATE AND LOCAL GOVERNMENT ITSELF IS A PARTNER IN DEVELOPING A NEW PRODUCTION PROCESS, A NEW TECHNOLOGY OR A NEW INVENTION. SOME STATE AND LOCAL GOVERNMENTS HAVE ESTABLISHING LABORATORIES, EXPERIMENTAL MANUFACTURING FACILITIES OR EDUCATION INSTITUTIONS WHICH CONDUCT BASIC OR APPLIED RESEARCH. SOME STATES HAVE ESTABLISHED INCUBATORS WHICH PROVIDE LOW-COST PHYSICAL SPACE, EQUIPMENT, AND TECHNICAL SERVICE TO START-UP BUSINESSES. THESE INITIATIVES ARE OF GREAT INTEREST TO THE OTHER STATES AND TO THE FEDERAL GOVERNMENT ITSELF.

ONE OF THE BEST EXAMPLES OF STATE TECHNOLOGY EFFORTS CAN BE FOUND IN ARKANSAS. THE ARKANSAS SCIENCE AND TECHNOLOGY AUTHORITY PLAYS A LEADING ROLE IN ARKANSAS IN IDENTIFICATION, DEVELOPMENT AND APPLICATION OF ADVANCED TECHNOLOGIES. IT PROVIDES FUNDING FOR BASIC RESEARCH AND APPLIED RESEARCH PARTNERSHIPS WITH INDUSTRY, WHICH INDUSTRIES IN TURN ARE ELIGIBLE FOR STATE RESEARCH AND DEVELOPMENT TAX CREDITS. IT STIMULATES A

HOME-GROWN ECONOMY THROUGH THE ESTABLISHMENT OF FIVE BUSINESS INCUBATORS WHICH PROVIDE SUPPORT TO NEW TECHNOLOGY-BASED BUSINESSES IN ARKANSAS. IT'S SEED CAPITAL INVESTMENT FUND PROVIDES THE CRITICAL INITIAL CAPITALIZATION FOR THESE NEW VENTURES. SUPPLEMENTING THE WORK OF A.S.TA. IS THE CENTER FOR TECHNOLOGY TRANSFER AT THE UNIVERSITY OF ARKANSAS, THE QUALITY-PRODUCTIVITY TASK FORCE OF THE ARKANSAS INDUSTRIAL DEVELOPMENT COMMISSION, AND THE INDUSTRIAL SERVICES ASSOCIATION AT SOUTHERN ARKANSAS UNIVERSITY ALL OF WHICH ARE WORKING WITH EXISTING INDUSTRIES IN ARKANSAS TO FIND WAYS TO INCREASE PRODUCTIVITY AND PROMOTE THE CONCEPT OF QUALITY MANAGEMENT.

ONE OF THE FUNDAMENTAL QUESTIONS WE HAVE IN THIS WHOLE FIELD OF COMPETITIVENESS IS TO WHAT EXTENT A GOVERNMENTAL UNIT SHOULD ITSELF BE A PARTNER IN ADVANCING THE STATE OF SCIENTIFIC AND TECHNICAL KNOWLEDGE. WE NEED TO KNOW MORE ABOUT WHEN AND HOW GOVERNMENTS SHOULD CONDUCT OR ORGANIZE RESEARCH EFFORTS AND WHICH RESEARCH EFFORTS HAVE THE GREATEST PAY-OFF TO THE WHOLE COMMUNITY.

ONE OF THE MOST INTERESTING AREAS FOR THE CENTER TO EXPLORE IS HOW STATES ARE BRINGING ENTREPRENEURS AND INVENTORS INTO THE CLASSROOM WHERE BOTH THEY AND THE STUDENTS CAN INTERACT. UNIVERSITIES HAVE HISTORICALLY SERVED AS AN IMPORTANT RESOURCE FOR THE AGRICULTURE INDUSTRY, CONDUCTING RESEARCH ON NEW CROPS AND AGRICULTURE TECHNIQUES AND PROVIDING EXTENSION SERVICES TO FARMERS.

MANY STATES ARE ESTABLISHING PROGRAMS WHICH INTEGRATE UNIVERSITIES IN THE SEARCH FOR MORE PRODUCTIVE PROCESSES, NEW TECHNOLOGY AND GREATER ECONOMIC GROWTH. UNIVERSITIES NO LONGER ARE THE IVORY TOWERS THAT SOME HAVE THOUGHT THEY SHOULD BE. ("THE HIGHER EDUCATION - ECONOMIC DEVELOPMENT CONNECTION: EMERGING ROLES FOR PUBLIC COLLEGES AND UNIVERSITIES IN A CHANGING ECONOMY," AMERICAN ASSOCIATION OF COLLEGES AND UNIVERSITIES AND SRI INTERNATIONAL, 1986.) GEORGIA INSTITUTE OF TECHNOLOGY, THE UNIVERSITY OF ALABAMA AT TUSCALOOSA, GEORGE MASON UNIVERSITY, MICHIGAN STATE UNIVERSITY AND OREGON STATE UNIVERSITY HAVE BEEN LEADERS IN FASHIONING INNOVATIVE UNIVERSITY/PRIVATE SECTOR PROGRAMS. MANY OTHER STATES ARE INVOLVED IN SIMILAR EFFORTS.

ANOTHER AREA OF ACTIVITY FOR STATE AND LOCAL GOVERNMENTS IS ASSISTANCE TO FIRMS IN MARKETING THEIR PRODUCTS IN DOMESTIC OR INTERNATIONAL MARKETS. IN OTHERS, IT INVOLVES PROVIDING ASSISTANCE IN ANALYZING MARKETS, DEMOGRAPHICS OR SALES STRATEGY. MANY STATES PROVIDE MANAGEMENT ASSISTANCE TO SMALL BUSINESSES.

THERE ARE AT LEAST TEN STATES WHICH ARE WORKING ON PROGRAMS TO ASSIST SMALL AND MEDIUM SIZED COMPANIES IN FINANCING EXPORT SALES. IN CALIFORNIA A GOVERNMENT AGENCY WILL GUARANTEE 85% REPAYMENT OF ON LOANS WHICH BANKS GIVE TO BUSINESSES TO FINANCE WORKING CAPITAL OR RECEIVABLES RELATED TO EXPORTS. IN ILLINOIS THE AGENCY WILL LEND BANKS 90% OF THE FUNDS THEY USE TO MAKE AN EXPORT-RELATED LOAN AND HAS ARRANGED FOR THE EXPORT-IMPORT BANK TO INSURE THE STATE, THE LENDER AND THE EXPORTER AGAINST MOST LOSSES ON AN EXPORT SALE. THERE ARE MAXIMUM AMOUNTS

TO THESE LOAN GUARANTEES OR LOANS, $350,000 IN THE CASE OF CALIFORNIA AND $500,000 IN THE CASE OF ILLINOIS. SO FAR THE CALIFORNIA AGENCY HAS MADE 23 LOAN GUARANTEES AND THE ILLINOIS AGENCY HAS BACKED SIX SALES. ("STATES LAUNCH EFFORTS TO MAKE SMALL FIRMS BETTER EXPORTERS," THE WALL STREET JOURNAL, FEBRUARY 2, 1987.)

VENTURE CAPITAL INITIATIVES

SOME STATE AND LOCAL GOVERNMENTS HAVE BECOME VENTURE CAPITALISTS, SUPPLEMENTING THE CAPITAL MARKETS WITH PUBLIC FUNDS OR WITH INVESTMENTS FROM PENSION PLANS OF PUBLIC EMPLOYEES. THERE IS NO QUESTION THAT OBTAINING VENTURE CAPITAL IS A PRE-CONDITION TO FOUNDING A FIRM. WITHOUT VENTURE CAPITAL A FIRM MAY NOT BE ABLE TO TEST A NEW TECHNOLOGY, BUILD A NEW PRODUCTION PROCESS, OR CONDUCT THE RESEARCH WHICH LEADS TO NEW DISCOVERIES.

IN A 1984 REPORT, THE SMALL BUSINESS ADMINISTRATION FOUND THAT 26 STATES WERE EXPERIMENTING IN OFFERING EQUITY FINANCIAL INDUCEMENTS TO GROWING COMPANIES AND THEIR INVESTORS. THESE EFFORTS INVOLVE MAKING OR INSURING LOANS, ISSUING BONDS, AUTHORING TAX-EXEMPT STATUS, MAKING GUARANTEES, GRANTS, EQUITY INVESTMENTS AND PROVIDING TECHNICAL ASSISTANCE. ("STATE ACTIVITIES IN VENTURE CAPITAL, EARLY-STAGE FINANCING, AND SECONDARY MARKETS," U.S. SMALL BUSINESS ADMINISTRATION, MAY 1984.)

THE VENTURE CAPITAL INITIATIVES OF STATE AND LOCAL GOVERNMENTS MAY BE THE MOST CONTROVERSIAL OF THE INITIATIVES BEING UNDERTAKEN. THERE ARE SOME WHO WILL ARGUE THAT THERE IS NO APPROPRIATE PLACE FOR PUBLIC FUNDS TO BE USED FOR THIS PURPOSE. THIS IS THE ARGUMENT WHICH WAS RAISED ABOUT A NATIONAL INDUSTRIAL DEVELOPMENT BANK. VENTURE CAPITALISTS IN THE PRIVATE SECTOR HAVE ENOUGH TROUBLE WITH THEIR INVESTMENTS TO HAVE CONFIDENCE THAT THE PUBLIC SECTOR WILL DO A BETTER JOB OR EVEN AS WELL AS THEY DO. ON THE OTHER HAND, THERE ARE THOSE WHO ARGUE THAT PUBLIC VENTURE CAPITAL IS NEEDED, PARTICULARLY IN AREAS OF THE COUNTRY WHICH PRIVATE INVESTORS MIGHT DISMISS AS HOPELESSLY DEPENDENT ON CONVENTIONAL FINANCING AND MANUFACTURING. ("STATES BACK RISKY VENTURES IN EFFORT TO CREATE NEW JOBS," NEW YORK TIMES, JUNE 23, 1986.)

WITH RESPECT TO STATE AND LOCAL VENTURE CAPITAL PROGRAMS, THE CLEARINGHOUSE SHOULD FOCUS MORE ON HOW THE STATE AND LOCAL GOVERNMENTS ESTABLISH THEIR INVESTMENT STRATEGY, WHAT FORM THE INVESTMENTS TAKE, HOW THE STATE INVOLVEMENT RELATES TO THAT OF OTHER INVESTORS, HOW THEY SUPPLEMENT VENTURE CAPITAL WITH OTHER FORMS OF ASSISTANCE, AND HOW THEY MEASURE THE SUCCESS OF THE VENTURE. THE CLEARINGHOUSE SHOULD FOCUS ON HOW THESE GOVERNMENT PROGRAMS COMPARE IN STIMULATING ECONOMIC DEVELOPMENT TO THOSE OF THE PRIVATE CAPITAL MARKET.

IMPORTANCE OF SMALL BUSINESS

MANY OF THE INITIATIVES OF STATE AND LOCAL GOVERNMENTS FOCUS ON SMALL BUSINESSES. THIS FOCUS IS ENTIRELY APPROPRIATE AS SMALL BUSINESSES TEND TO BE LEADERS IN ENHANCING PRODUCTIVITY, TECHNOLOGY AND INNOVATION.

EMPLOYMENT GROWTH IN SMALL BUSINESS-DOMINATED INDUSTRIES, AT 5.1%, FAR OUTPACED THAT OF LARGE BUSINESS DOMINATED INDUSTRIES, AT .7%. ("THE STATE OF SMALL BUSINESS," REPORT OF THE PRESIDENT, 1986, AT XIII.) SMALL FIRMS GENERATED MOST OF THE NET NEW JOBS DURING THE ECONOMIC DOWNTURNS FROM 1979 TO 1983 AND THEY CONTINUE TO BE THE MAJOR EMPLOYER OF YOUNGER AND OLDER WORKERS, WOMEN AND VETERANS.

IT IS QUITE CLEAR THAT THE SMALL FIRMS WHICH THRIVE ON VENTURE CAPITAL INVESTMENTS MAKE A MAJOR CONTRIBUTION TO THE ECONOMIC GROWTH OF THE COUNTRY. IN ONE STUDY OF 72 FIRMS IN WHICH VENTURE CAPITALISTS HAD INVESTED ONLY $209 MILLION DURING THE 1970'S, THE FIRMS HAD COMBINED ANNUAL SALES IN 1979 OF $6 BILLION AND HAD CREATED 130,000 JOBS. ("GOVERNMENT-INDUSTRY COOPERATION CAN ENHANCE THE VENTURE CAPITAL PROCESS," GENERAL ACCOUNTING OFFICE, AUGUST 1982, APPENDIX II, PAGE 9.)

SMALL BUSINESSES ALSO HAVE BEEN FOUND TO BE PROLIFIC INVENTORS AND INNOVATORS. IN ONE STUDY COVERING 635 PRODUCT INNOVATIONS MARKETED IN THE UNITED STATES DURING THE 1970'S FOUND THAT 40% WERE TRACKED TO SMALL FIRMS OR INDIVIDUAL ENTREPRENEURS. ("STATE OF SMALL BUSINESS," REPORT OF THE PRESIDENT, 1983, AT

122.) SEVEN OTHER STUDIES HAVE REACHED SIMILAR CONCLUSIONS. (ID. AT 123.)

BECAUSE OF THE IMPORTANCE OF SMALL BUSINESS, THE CENTER IS SPECIFICALLY DIRECTED TO COLLECT INFORMATION ON INITIATIVES, "PARTICULARLY INFORMATION USEFUL TO...SMALL BUSINESS." (SECTION 5A.(B)2).) THE RECORD IS CLEAR THAT SMALL BUSINESSES WILL, IN FACT, MAKE GOOD USE OF THIS INFORMATION IN THEIR OWN EFFORTS. BY FOCUSING ON THE NEEDS OF SMALL BUSINESS, THE CENTER CAN ENSURE THAT ITS MISSION TO PROMOTE PRODUCTIVITY, TECHNOLOGY AND INNOVATION WILL BE ACHIEVED.

COOPERATION AMONG THE STATES

WITH RESPECT TO THESE EFFORTS THE CENTER IS DIRECTED TO SERVE AS A CLEARINGHOUSE TO DISSEMINATE INFORMATION ON HOW THESE ASSISTANCE EFFORTS ARE ORGANIZED, WHICH TYPES OF ASSISTANCE SEEM MOST TO BE IN NEED, AND WHICH AGENCIES HAVE DEVELOPED USEFUL DATA BASES WHICH COULD BE USED BY OTHER AGENCIES. INDEED, IT MAY BE THAT STATES CAN SHARE THEIR RESOURCES WITH ONE ANOTHER.

NORMALLY A STATE OR LOCAL GOVERNMENT AGENCY PROVIDES SERVICES ONLY TO THE FIRMS AND RESIDENCES WITHIN ITS JURISDICTION, BUT THERE IS NO REASON WHY ONE AGENCY MIGHT NOT PROVIDE SERVICES TO ANOTHER AGENCY, EITHER AS A MATTER OF COMITY OR UNDER A CONTRACT. IT ONE STATE DEVELOPS A DATA BASE ON EXPORT MARKETS FOR A CERTAIN TYPE OF PRODUCT, PERHAPS THAT DATA BASE COULD BE MADE AVAILABLE TO OTHER STATE AGENCIES. THE CENTER MAY

BE ABLE TO HELP THE STATE AND LOCAL GOVERNMENTS TO AVOID DUPLICATION IN DEVELOPING DATA BASES AND TO COOPERATE AMOUNT THEMSELVES IN SHARING INFORMATION AND EXPERIENCES.

EVALUATING STATE AND LOCAL INITIATIVES

ONE AREA WHERE STATE AND LOCAL GOVERNMENTS MAY NEED DIRECT FINANCIAL ASSISTANCE IS IN EVALUATING THE INITIATIVES THEY HAVE UNDERTAKEN. TYPICALLY, EVALUATION IS THE HARDEST AND MOST UNDERFUNDED ASPECT OF A PROGRAM.

IN SOME CASES, THERE MAY BE A RELUCTANCE TO EVALUATE A PROGRAM FOR FEAR THAT IT WILL BE FOUND WANTING. I SAY THIS KNOWING THAT THIS SAME RELUCTANCE IS COMMON IN PRIVATE BUSINESSES, ESPECIALLY FOR PROGRAMS WHERE SUCCESS AND FAILURE IS NOT MEASURED SIMPLY BY A REFERENCE TO PROFIT AND LOSS.

TO BE FAIR, HOWEVER, IT IS VERY HARD TO DETERMINE WHEN AN INITIATIVE OF A GOVERNMENT AGENCY HAS MADE THE DIFFERENCE IN INCREASING THE PRODUCTIVITY OF A FIRM. PRODUCTIVITY ITSELF IS A CONCEPT THAT IS HARD TO PIN DOWN. IT IS HARD TO KNOW WHY SOME FIRMS ARE MORE INVENTIVE THAN OTHERS. IT IS HARD TO SAY WHY ONE SCIENTIST DISCOVERS A NEW TECHNOLOGY AND ANOTHER DOES NOT. THERE IS CONTROVERSY ABOUT HOW TO EVALUATE A PROGRAM JUST AS THERE IS IN DESIGNING A PROGRAM IN THE FIRST PLACE.

IN ADDITION TO SERVING AS A CLEARINGHOUSE, THEREFORE, THE LEGISLATION AUTHORIZES THE CENTER TO PROVIDE GRANTS TO HELP

STATE AND LOCAL GOVERNMENTS EVALUATE THEIR INITIATIVES. (SECTION 5A.(C)(2).) THESE GRANTS COULD BE GIVEN TO THE LOCAL AGENCY OR TO A THIRD PARTY, WHICHEVER IS MOST APPROPRIATE. THE LEGISLATION BARS THE CENTER FROM PROVIDING FINANCIAL ASSISTANCE FOR THE INITIATIVE ITSELF, BUT IT IS QUITE APPROPRIATE FOR THE CENTER TO PROVIDE SUCH ASSISTANCE FOR EVALUATION BECAUSE ONLY WITH PROPER EVALUATION CAN THE CENTER DETERMINE THE EFFECTIVENESS OF THE INITIATIVE.

THE ISSUE OF EVALUATIONS IS SURE TO BE A SENSITIVE ONE AS WELL AS AN IMPORTANT ONE. STATE AND LOCAL GOVERNMENTS WHICH ARE UNDERTAKING EXPERIMENTAL PROGRAMS HAVE NO INTEREST WHATEVER IN THE FEDERAL GOVERNMENT -- WHICH HAS SHOWN LITTLE WILLINGNESS TO UNDERTAKE ANY INITIATIVES ON COMPETITIVENESS -- CRITICIZING THEIR EFFORTS. IF THE FEDERAL GOVERNMENTS CHOOSES TO BE INACTIVE ON COMPETITIVENESS ISSUES, IT HAS NO RIGHT TO MAKE LIFE MORE DIFFICULT FOR STATE AND LOCAL GOVERNMENTS WHICH ARE TAKING UP THE SLACK. THIS IS AN ISSUE OF SOVEREIGNTY AS WELL AS TACT. BUT, THE CENTER WILL FIND THAT IT CANNOT HOPE TO ESTABLISH A RELATIONSHIP OF TRUST WITH STATE AND LOCAL GOVERNMENTS IF IT SIMPLY CRITICIZES THEIR EFFORTS FROM "ON HIGH."

TO ENSURE THAT THE CENTER DOES NOT TRAMPLE ON THE PREROGATIVES OF STATE AND LOCAL GOVERNMENTS, THE BILL EXPLICITELY PROVIDES THAT THE CENTER MAY NOT EVALUATE A STATE OR LOCAL INITIATIVE OR DISSEMINATE INFORMATION REGARDING SUCH EVALUATIONS UNLESS THE STATE OR LOCAL GOVERNMENT CARRYING OUT THE INITIATIVE "CONSETS TO AND COOPERATES WITH SUCH EVALUATION." (SECTION 5A

(C)(2).) THIS LIMITATION WILL ENSURE THAT WHEN THE CENTER DOES CONDUCT AN EVALUATION, IT WILL BE FULLY INFORMED OF THE NATURE AND TERMS OF THE LOCAL INITIATIVE. IT CANNOT HOPE TO HAVE ALL THE INFORMATION IT NEEDS IF THE STATE AND LOCAL GOVERNMENT IS UNWILLING TO PROVIDE IT. BUT, IT NEEDS MORE THAN ACCESS TO DATA. IT NEEDS TO DISCUSS THE INITIATIVE WITH THE STATE AND LOCAL GOVERNMENT OFFICIALS INVOLVED TO LEARN FROM THEIR VIEWS AND THEIR EXPERIENCE.

THE STATE AND LOCAL GOVERNMENT AND THE CENTER HAVE AN INTEREST IN THE OBJECTIVITY OF THE EVALUATION AND ANY GRANT SHOULD BE AWARDED WITH THIS NEED CLEARLY IN MIND. THERE WILL BE MANY VESTED INTERESTS INVOLVED IN ANY INITIATIVE AND IT WILL SOMETIMES BE DIFFICULT TO OBTAIN OBJECTIVE EVALUATIONS, ESPECIALLY IF THE EVALUATION OF THE INITIATIVE FINDS THAT IT HAS NOT ACHIEVED ITS PURPOSE OR MATCHED CLAIMS OF SUCCESS. TO BETTER ENSURE THAT THE EVALUATIONS PERFORMED UNDER CONTRACTS FUNDED BY THE CENTER ARE OBJECTIVE, THE BILL INCLUDES A PROCEDURE FOR DETERMINING WHETHER THE ORGANIZATION RECEIVING THE CONTRACT HAS AN ORGANIZATIONAL CONFLICT OF INTEREST. THIS PROCEDURE HAS WORKED WELL WITH THE DEPARTMENT OF ENERGY AND THERE IS AN EXTENSIVE LEGISLATIVE HISTORY TO THE PROVISION. ("ORGANIZATIONAL CONFLICT OF INTEREST IN GOVERNMENT CONTRACTING," HEARINGS OF THE SUBCOMMITTEE ON ENERGY RESEARCH AND WATER RESOURCES, COMMITTEE ON INTERIOR AND INSULAR AFFAIRS, UNITED STATES SENATE, 1975.

IN ADDITION, THERE IS A NEED FOR THE CENTER TO FUND GENERIC RESEARCH IN HOW ANY GOVERNMENTAL AGENCY CAN MEASURE THE

EFFECTIVENESS OF ITS COMPETITIVENESS INITIATIVES. THE BILL I AM INTRODUCING PERMITS THE CENTER TO AWARD SOME GRANTS FOR THIS PURPOSE. (SECTION 5A.(F).) WHILE THE CENTER MAY FUND THIS RESEARCH, IT MUST BE VERY CAREFUL IN COMMISSIONING SUCH RESEARCH. IT MUST BE SURE THAT THE RESEACH WILL BE HELPFUL IN ACTUALLY CONDUCTING EVALUATIONS, NOT SIMPLY IN PROVIDING INTERESTING COMMENTARY ON COMPLEX ISSUES.

WITH RESPECT TO BOTH EVALUATIONS AND BASIC RESEARCH, THE CENTER MUST ALLOCATE AN APPROPRIATE AMOUNT FROM ITS APPROPRIATIONS, WHICH ARE LIMITED. IN THE END, THE CENTER WILL HAVE LESS THAN HALF A MILLION DOLLARS FOR THIS PURPOSE. OVER TIME, WE IN CONGRESS CAN ADJUST THE AUTHORIZATIONS AND APPROPRIATIONS FOR THE CENTER AS WE LEARN HOW MUCH FUNDING IS NEEDED FOR THESE EVALUATIONS AND BASIC RESEARCH.

THE INTEREST OF THE CENTER IN ASSISTING STATE AND LOCAL GOVERNMENTS TO EVALUATE THEIR INITIATIVES IS, IN PART, A SELFISH INTEREST. THE CENTER IS JUST AS INTERESTED IN THE RESULTS OF THESE EVALUATIONS AS ARE THOSE INVOLVED IN THE INITIATIVE. THE CENTER IS INTERESTED IN DISSEMINATING INFORMATION ON THE MOST SUCCESSFUL INITIATIVES AND IN DISSEMINATING INFORMATION ON HOW EACH INITIATIVE COMPARES TO OTHERS AND IT NEEDS AS MUCH DATA AS IT CAN ASSEMBLE ON THE IMPACT OF THESE PROGRAMS.

THE CENTER AS AN ADVISOR

WITH ITS EXPERIENCE AS A CLEARINGHOUSE AND WITH THE RESULTS OF ITS RESEARCH PROGRAM, THE CENTER CAN BECOME A KNOWLEDGEABLE ADVISOR AS WELL AS A MONITOR OF DEVELOPMENTS. IT MAY FIND THAT IT CAN PROVIDE MANAGEMENT ADVICE TO STATE AND LOCAL GOVERNMENTS ON HOW THEY CAN ORGANIZE SUCCESSFUL INITIATIVES. IT MAY BE ABLE TO APPROACH STATE AND LOCAL GOVERNMENTS WITH SUGGESTIONS ON HOW TO CHANGE A PROGRAM OR SUPPLEMENT A PROGRAM WITH ANOTHER INITIATIVE TO MAKE IT MORE EFFECTIVE. THE CENTER IS SPECIFICALLY AUTHORIZED TO PROVIDE ADVICE AND TECHNICAL ASSISTANCE TO STATE AND LOCAL GOVERNMENT AGENCIES UNDER THE TERMS OF THE BILL. (SECTION 5A.(E).)

THE CENTER CAN BE ESPECIALLY HELPFUL IN BRINGING TOGETHER STATE AND REGIONAL EFFORTS TO ACCOMPLISH A SIMILAR OBJECTIVE, SUCH AS ESTABLISHMENT OF A CENTER ON ADVANCED MATERIALS. THE CENTER MAY BE ABLE TO HELP STATE AND REGIONAL ORGANIZATIONS TO AVOID DUPLICATION AND ENSURE THAT THE LIMITED RESOURCES WHICH ARE AVAILABLE ARE NOT SQUANDERED AND DILUTED BY A SURFEIT OF UNDERFUNDED CENTERS IN ONE PARTICULAR TECHNOLOGICAL AREA. THE MOST EFFECTIVE WAY TO PROCEED MAY BE TO ESTABLISH ONE CENTER WHICH WILL ACHIEVE A CRITICAL MASS OF RESOURCES AND TALENT WHICH CAN HAVE AN IMPACT ON THE COMPETITIVENESS OF THE UNITED STATES. IT MAY WELL BE THAT THE FEDERAL GOVERNMENT SHOULD FUND SUCH A CENTER RATHER THAN FOR SEVERAL STATE OR REGIONAL ORGANIZATIONS TO FUND IT AND THE CENTER CAN BRING TOGETHER THE INTERESTED PARTIES TO MAKE THAT DETERMINATION.

THE CENTER MAY ALSO BECOME AN ADVISOR TO OTHER FEDERAL GOVERNMENT AGENCIES. IT CAN KEEP THESE OTHER AGENCIES INFORMED OF DEVELOPMENTS WHICH MAY BE OF INTEREST TO THEM, EITHER IN MODIFYING A SIMILAR FEDERAL GOVERNMENT PROGRAM OR IN PROVIDING ASSISTANCE TO A STATE PROGRAM. THE CENTER MAY BE ABLE TO SERVE AS A MEDIATOR BETWEEN STATE AND FEDERAL AGENCIES IN AREAS OF COMMON INTEREST OR TO FACILITATE COOPERATIVE JOINT EFFORTS.

CENTER CANNOT INTRUDE

IT IS VITAL THAT THE CENTER IN ITS ACTIVITIES DOES NOT DOMINATE OR CONTROL THE STATE AND LOCAL GOVERNMENTS. THE PURPOSE OF THE CENTER IS TO MONITOR AND ASSIST INNOVATIVE STATE AND LOCAL INITIATIVES. THE VALUE OF THIS EFFORT COMES IN THE VARIETY OF THESE INITIATIVES. IF THE CENTER COMES TO DOMINATE AND CONTROL THESE INITIATIVES, IT WILL STIFLE THE VERY CREATIVITY THAT GIVES RISE TO THE NEED FOR THE CENTER.

THIS IS TRUE IN EVALUATING THE STATE AND LOCAL GOVERNMENT INITIAITIVES. IT CERTAINLY IS TRUE IN PROVIDING TECHNICAL ASSISTANCE AND ADVICE TO THE LOCAL AGENCIES. IN NONE OF THESE EFFORTS DOES THE CENTER HAVE NOR SHOULD IT HAVE ANY AUTHORITY TO DEMAND THAT THE STATE AND LOCAL GOVERNMENTS COOPERATE WITH IT. IT MAY NOT DEMAND INFORMATION FROM THE GOVERNMENT ABOUT THE EFFECTIVENESS OR RESULTS OF THE PROGRAM. IT MAY NOT OBTAIN ANY PROPRIETARY INFORMATION ON TECHNOLOGY FROM ANY FIRM PARTICIPATING IN A PROGRAM.

SIMILARLY, THE CENTER MAY NOT DIRECT ANOTHER FEDERAL GOVERNMENT AGENCY TO TAKE ANY ACTION OR MODIFY ANY PROGRAM. IT MAY "STUDY WAYS IN WHICH FEDERAL AGENCIES CAN USE EXISTING POLICIES AND PROGRAMS TO ASSIST STATE AND LOCAL GOVERNMENTS IN CARRYING OUT (THEIR) INITIATIVES," IT MAY "MAKE PERIODIC RECOMMENDATIONS TO THE ASSISTANT SECRETARY (FOR PRODUCTIVITY, TECHNOLOGY AND INNOVATION) CONCERNING MODIFICATIONS IN SUCH POLICIES AND PROGRAMS," AND IT MAY "CONVENE MEETINGS AND CONFERENCES OF FEDERAL, STATE AND LOCAL OFFICIALS IN ORDER TO CARRY OUT JOINT AND COOPERATIVE INITIATIVES" BUT IN NONE OF THESE EFFORTS DOES THE CENTER HAVE ANY AUTHORITY OVER OTHER FEDERAL GOVERNMENT AGENCIES. (SECTION 5A.(D)(1), (2) AND (3).)

THE CENTER MUST "ESTABLISH RELATIONSHIPS WITH STATE AND LOCAL GOVERNMENTS" BEFORE IT CAN SERVE AS A PARTNER AND A RESOURCE. (SECTION 5A.(B)(1).) THESE RELATIONSHIPS MUST BE BASED ON TRUST AND THEY MUST BE VOLUNTARY. THE CREDIBILITY AND USEFULNESS OF THE CENTER, AND IT ACCESS TO INFORMATION AND DATA, WILL DEPEND ON THE VALUE OF THE ASSISTANCE IT CAN PROVIDE AND THE SENSITIVITY IT HAS TO THE AUTONOMY OF STATE AND LOCAL GOVERNMENTS.

THE POWER OF THE CENTER IS INFORMATION. ITS ABILITY TO AWARD GRANTS IS NOT SO GREAT THAT THIS ALONE WILL PERSUADE STATE AND LOCAL GOVERNMENTS AND OTHER FEDERAL AGENCIES TO COOPERATE.

I AM CONFIDENT THAT THE CENTER CAN ESTABLISH A STRONG WORKING RELATIONSHIP WITH STATE AND LOCAL GOVERNMENTS AND OTHER

FEDERAL AGENCIES. THE REASON WHY STATE AND LOCAL GOVERNMENTS TAKE THE INITIATIVE TO STIMULATE PRODUCTIVITY, TECHNOLOGY AND INNOVATION IS THAT THEY ARE PUBLIC SPIRITED. I AM SURE THAT THEY WILL BE DELIGHTED TO WORK COOPERATIVELY WITH THE NEW CENTER AND TO ASSIST OTHER AGENCIES TO ACCOMPLISH THE SAME OBJECTIVES AS THEY SEEK TO ACCOMPLISH. THE SAME IS TRUE OF OTHER FEDERAL GOVERNMENT AGENCIES.

INDEED, WE ARE ALL AFFECTED BY THE DECLINE IN THE COMPETITIVENESS OF OUR COUNTRY. WE NEED TO WORK TOGETHER ON THE PROBLEM. IF OUR EFFORTS DEGENERATE INTO A COMPETITION FOR WHAT REMAINS OF A SHRINKING ECONOMY, WE ALL ARE SURE TO SUFFER EVEN MORE. THIS IS WHY WE NEED A CLEARINGHOUSE TO BRING US TOGETHER, TO LEARN FROM ONE ANOTHER, AND TO COOPERATE FOR OUR COMMON GOOD.

MISCELLANEOUS PROVISIONS

THE CENTER IS AUTHORIZED TO ENTER INTO CONTRACTS ITSELF, OR JOINTLY WITH OTHER FEDERAL AGENCIES, "WITH PUBLIC AND NONPROFIT PRIVATE ENTITIES" IN PERFORMING ITS FUNCTIONS AS A CLEARINGHOUSE, EVALUATOR AND TECHNICAL ADVISOR. (SECTION 5A.(K)(2)(B).) IT IS ALSO AUTHORIZED TO ENTER INTO CONTRACTS FOR EVALUATION WHICH ARE PARTLY OR WHOLLY FUNDED BY "ANOTHER FEDERAL AGENCY, A STATE OR LOCAL GOVERNMENT, OR A PUBLIC OR NONPROFIT PRIVATE ENTITY." (SECTION 5A.(C)(3).) THE CENTER HAS THE FLEXIBILITY IT NEEDS TO PERFORM ITS FUNCTIONS.

THE CENTER MIGHT FIND, FOR EXAMPLE, THAT EXISTING STATE OR REGIONAL ORGANIZATIONS HAVE COMPILED USEFUL LISTS AND DESCRIPTIONS OF STATE AND LOCAL INITIATIVES AND IT MIGHT PROVIDE SOME CONTRACT FUNDS TO THESE ORGANIZATIONS TO CONTINUE AND EXPAND THEIR EFFORTS. IT MIGHT FIND THAT A REGIONAL BODY COULD ORGANIZE AN IMPORTANCE CONFERENCE ON AN IMPORTANT ISSUE. OR IT MIGHT FIND THAT A NONPROFIT AGENCY COULD PROVIDE TECHNICAL ASSISTANCE TO A NUMBER OF STATE GOVERNMENTS.

THE CENTER IS DIRECTED TO ISSUE AN ANNUAL REPORT TO BE TRANSMITTED TO THE CONGRESS ON ITS ACTIVITIES. (SECTION 5A.(G).) THE REPORT IS REQUIRED TO INCLUDE A DESCRIPTION OF THE INITIATIVES OF STATE AND LOCAL GOVERNMENTS, SUMMARIES OF ANY EVALUATIONS OF THESE INITIATIVES UNDERTAKEN BY THE CENTER, DESCRIPTIONS OF ANY BASIC RESEARCH UNDERTAKEN BY THE CENTER, AND THE RECOMMENDATIONS OF THE CENTER ON WAYS FEDERAL AGENCIES CAN BE MORE HELPFUL TO STATE AND LOCAL GOVERNMENTS IN ENHANCING THE COMPETITIVENESS OF U.S. BUSINESS.

THE DIRECTOR OF THE CENTER IS AUTHORIZED TO ESTABLISH AN ADVISORY BOARD TO ASSIST IT IN ITS ACTIVITIES. THE DIRECTOR SHALL APPOINT A "BROAD RANGE OF MEMBERS" TO THE BOARD "INCLUDING OFFICERS OF STATE AND LOCAL GOVERNMENTS, LEADERS IN BUSINESS AND LABOR, AND EXPERTS ON PRODUCTIVITY, TECHNOLOGY AND INNOVATION." (SECTION 5A (L).) THE ADVISORY BOARD HAS SOME INDEPENDENCE FROM THE CENTER AND IT CAN "MAKE RECOMMENDATIONS TO THE ASSISTANT SECRETARY, THE DIRECTOR, AND THE CONGRESS CONCERNING WAYS IN WHICH FEDERAL AGENCIES (INCLUDING THE CENTER ITSELF) CAN USE

EXISTING POLICIES AND PROGRAMS TO ASSIST STATE AND LOCAL GOVERNMENTS" WITH THEIR INITIATIVES. THE ADVISORY BOARD SHOULD OFFER FRANK AND CONSTRUCTIVE ADVICE TO THE ASSISTANT SECRETARY AND THE DIRECTOR AND IT CAN SERVE AS A VITAL BRIDGE BETWEEN THE CENTER AND STATE AND LOCAL GOVERNMENTS. IT IS VITAL THAT THE BOARD ENJOY THE CONFIDENCE BOTH OF THE ASSISTANT SECRETARY, THE DIRECTOR AND THE CONGRESS, BUT ALSO OF THE STATE AND LOCAL GOVERNMENT AGENCIES.

THE CENTER IS DIRECTED TO WORK CLOSELY WITH OTHER FEDERAL AGENCIES INTERESTED IN ENHANCING THE COMPETITIVENESS OF U.S. BUSINESS, INCLUDING THE DEPARTMENTS OF AGRICULTURE, DEFENSE, AND LABOR, THE NATIONAL SCIENCE FOUNDATION, AND THE SMALL BUSINESS ADMINISTRATION. (SECTION 5A (K)(2)(A).) THE CENTER IS SPECIFICALLY DIRECTED TO WORK CLOSELY WITH FEDERAL, STATE AND LOCAL AGENCIES "RESPONSIBLE FOR ENHANCING EXPORT OPPORTUNITIES FOR UNITED STATES BUSINESSES." (SECTION 5A(K)(2()(C).)

THE CENTER IN S. 930 IS AUTHORIZED $2 MILLION FOR FISCAL 1988, $3 MILLION IN FISCAL 1989 AND $4 MILLION IN 1990 AND THEREAFTER. THIS IS A MODEST SUM AND PERHAPS IT PROVIDES TOO LITTLE IN RESOURCES TO THE CENTER. THIS AUTHORIZATION INCLUDES FUNDS WHICH WOULD BE USED BY THE CENTER FOR GRANTS AND CONTRACTS FOR EVALUATIONS AND GENERIC RESEARCH. BECAUSE OF THE LIMITS ON FUNDS FOR THE CENTER, INITIALLY IT SHOULD FOCUS ITS EFFORTS ON ITS RESPONSIBILITIES AS A CLEARINGHOUSE RATHER THAN ON EVALUATIONS AND GENERIC RESEARCH. IT IS THE RESPONSIBILITY OF THE DIRECTOR, HOWEVER, TO DETERMINE HOW MUCH OF THE FUNDS

AVAILABLE TO THE CENTER SHALL BE ALLOCATED TO THE CLEARINGHOUSE, EVALUATION, AND GENERIC RESEARCH FUNCTIONS.

COMMERCE DEPARTMENT AND O.P.T.I.

IN MY BILL, THE NEW CENTER IS TO BE LOCATED IN THE OFFICE OF PRODUCTIVITY, TECHNOLOGY AND INNOVATION (OPTI) IN THE DEPARTMENT OF COMMERCE. OPTI IS AN AGENCY THAT I HAVE LONG SUPPORTED AND ON SEVERAL OCCASIONS I HAVE MADE SURE THAT THE ADMINISTRATION'S EFFORTS TO SLASH ITS BUDGET HAVE NOT BEEN SUCCESSFUL. INDEED, AT ONE POINT THE ADMINISTRATION ARGUED THAT OPTI SHOULD BE ABOLISHED BECAUSE ITS MISSION HAD BEEN "COMPLETED." IN FACT, OPTI IS A BRIGHT LIGHT IN THIS ADMINISTRATION AS AN AGENCY WHICH IS TRYING TO MAKE GOVERNMENT WORK, NOT SIMPLY TO AVOID DEALING WITH REAL PROBLEMS.

TO A VERY LIMITED EXTENT, THE FUNCTIONS OF THE CENTER ARE PERFORMED ALREADY BY THE OPTI. BECAUSE OPTI DOES MONITOR DEVELOPMENTS AT THE STATE AND LOCAL LEVEL AND SERVE TO A LIMITED EXTENT AS A CLEARINGHOUSE, THE BILL PLACES THE CENTER WITHIN OPTI. BY ESTABLISHING THE CENTER BY STATUTE, HOWEVER, WE CAN GIVE IT VISIBILITY, ENSURE IT HAS ENOUGH RESOURCES, AND LEND IT THE CREDIBILITY OF THE CONGRESS.

I ALSO BELIEVE IT IS IMPORTANT THE CENTER BE LOCATED IN THE EXECUTIVE BRANCH, NOT AS AN INDEPENDENT BODY. UNDER THE BILL THE DIRECTOR OF THE CENTER IS APPOINTED BY THE SECRETARY OF COMMERCE AND REPORTS TO THE SECRETARY "THROUGH THE ASSISTANT

SECRETARY" FOR PRODUCTIVITY, TECHNOLOGY AND INNOVATION. THIS MEANS THAT THE DIRECTOR WILL BE A PART OF THE ADMINISTRATION, NOT INDEPENDENT OF IT.

THERE IS SOME RISK IN THIS, ESPECIALLY IF THE CENTER IS PART OF AN ADMINISTRATION LIKE THE CURRENT ONE WHICH OPPOSES NEARLY ALL FORMS OF CONSTRUCTIVE PARTNERSHIPS BETWEEN THE PUBLIC AND PRIVATE SECTOR AND BETWEEN THE FEDERAL AND STATE GOVERNMENTS. BUT, TO BE EFFECTIVE -- PARTICULARLY IN ITS ROLE IN RECOMMENDING MODIFICATIONS OF CURRENT FEDERAL GOVERNMENT POLICIES AND PROGRAMS -- THE CENTER NEEDS TO BE ACCOUNTABLE TO AND A PART OF THE ADMINISTRATION. IT NEEDS TO HAVE POLITICAL CLOUT IN ORDER TO HELP STATE AND LOCAL GOVERNMENT AGENCIES IN DEALING WITH THE FEDERAL GOVERNMENT. IT NEEDS TO SPEAK FOR THE ADMINISTRATION WHEN IT IS CALLED BY THE CONGRESS TO MAKE RECOMMENDATIONS OR TO EVALUATE PROPOSED POLICIES.

THE CENTER BELONGS IN OPTI AND ITS EXISTENCE WILL ENHANCE EVERYTHING THAT OPTI ALREADY DOES TO STIMULATE THE COMPETITIVENESS OF THE COUNTRY. OPTI IS ONE OF THE ONLY CURRENT FEDERAL AGENCIES WHICH CAN UNDERSTAND AND APPRECIATE THE INITIATIVES OF STATE AND LOCAL GOVERNMENTS.

THE CHALLENGE WE FACE

IT MAY BE SAID THAT S. 930 IS NOT DRAMATIC ENOUGH OR MASSIVE ENOUGH. SOME WOULD ARGUE THAT WE NEED TO SPEND HUGE NEW SUMS ON SOME PROGRAMS ON COMPETITIVENESS. OTHERS WOULD ARGUE

THAT WE NEED TO ERECT BARRIERS TO THE IMPORTS WHICH ARE FLOODING OUR MARKETS. BUT I THINK THE COMPETITIVENESS PROBLEM IS MORE COMPLEX THAN THAT AND THAT WE NEED TO UNDERTAKE MANY DIFFERENT INITIATIVES TO HAVE AN IMPACT.

WE CANNOT PURSUE ANY SINGLE STRATEGY. OUR ECONOMY AND THE WORLD ECONOMY ARE TOO COMPLEX FOR ANY LEVEL OF GOVERNMENT -- FEDERAL, STATE OR LOCAL -- TO HAVE A MAJOR IMPACT ON THE COMPETITIVENESS OF THE PRIVATE SECTOR. THE RESOURCES OF GOVERNMENT CAN HELP BUT THE PRIVATE SECTOR HAS MANY TIMES THE RESOURCES AVAILABLE TO IT.

INDEED, IN MANY WAYS GOVERNMENT CANNOT AFFECT THE COMPETITIVENESS OF PRIVATE BUSINESS. THE COMPETITIVENESS OF A FIRM DEPENDS IN LARGE PART TO THE FORESIGHT OF ITS MANAGEMENT AND THE CREATIVITY OF ITS TECHNICAL PEOPLE. THESE ARE QUALITIES THAT CANNOT BE LEGISLATED.

BUT, THE GOVERNMENT MAY BE ABLE TO SERVE AS A PARTNER. THE STATE OR LOCAL GOVERNMENT MAY BE A MORE SENSITIVE AND MORE CONSTRUCTIVE PARTNER THAN CAN BE THE FEDERAL GOVERNMENT. THE GOVERNMENT CAN PROVIDE SOME LEADERSHIP. IT CAN ENCOURAGE RISK TAKING AND IT CAN PROVIDE INFORMATION.

WHAT THIS PROPOSAL SAYS IS TAHT WE NEED A DECENTRALIZED STRATEGY WHICH DRAWS ON THE CREATIVITY AND INNOVATION OF MANY SECTORS, PUBLIC AND PRIVATE, NON-PROFIT AND COMMERCIAL, EDUCATION AND TRAINING.

BY PURSUING A BROAD-BASED AND MULTI-FACETED STRATEGY, WE ARE MORE LIKELY TO ENJOY SUCCESS. VAST NEW FEDERAL PROGRAMS HAVE A POTENTIAL FOR DOING HARM AS WELL AS GOOD, ESPECIALLY IF THEY IMPEDE OUR EFFORTS TO CONTROL THE BUDGET DEFICIT.

GIVEN THE CONSTRAINTS ON FUNDING ANY NEW FEDERAL GOVERNMENT PROGRAMS, THE FEDERAL GOVERNMENT CAN START BY WORKING CONSTRUCTIVELY WITH STATE AND LOCAL AGENCIES WHICH ARE TAKING THE LEAD IN STIMULATING PRODUCTIVITY, TECHNOLOGY AND INNOVATION. IT CAN AT LEAST HELP US ALL TO LEARN ABOUT THE COMPLEX CHALLENGE WE FACE FROM INTERNATIONAL COMPETITION.

I VIEW S. 930 AS NON-PARTISAN AND NON-CONTROVERSIAL. THE AUTHORIZATION FOR THE NEW CENTER IS MODEST, ONLY $2 MILLION THE FIRST YEAR, $3 MILLION THE SECOND AND $4 MILLION THEREAFTER. THE CENTER'S POWERS ARE LIMITED AND IT IS PROHIBITED FROM BECOMING INVOLVED IN THE ON-GOING COMPETITION AMONG THE STATE AND LOCAL GOVERNMENTS ON ECONOMIC DEVELOPMENT. THE CENTER WILL ENHANCE THE EFFECTIVENESS OF STATE AND LOCAL GOVERNMENTS AND IT WILL HELP THE FEDERAL GOVERNMENT TO CHART ITS OWN COMPETITIVENESS PROGRAMS.

WE CAN ALL BENEFIT FROM THE INITIATIVES OF STATE AND LOCAL GOVERNMENTS IF WE SHARE INFORMATION ABOUT THEIR SUCCESSES AND FAILURES. THE CLEARINGHOUSE CAN BRING US TOGETHER WITH INFORMATION, WHICH CAN HELP TO BRING US TOGETHER FOR ACTION.

THE CENTER SPEAKS OF RISK TAKING, PARTNERSHIPS, AND LONG-TERM EFFORTS. IT IS NOT A PANACEA. IT DOES NOT OVER-PROMISE. IT DOES NOT UNDERESTIMATE THE COMPLEXITIES OF THE CHALLENGE. IT'S A MODEST PROPOSAL BUT THEREIN LIES IT VIRTUE. IT WILL HELP, IT IS CONSTRUCTIVE, IT IS PRAGMATIC AND IT IS SOMETHING WE CAN COME TOGETHER TO DO NOW WHILE WE DEBATE GRANDER AND MORE CONTROVERSIAL PROPOSALS.

A COPY OF THE BILL FOLLOWS.

II

100TH CONGRESS
1ST SESSION

S. 930

To amend the Stevenson-Wydler Technology Innovation Act of 1980 to establish a Center on State and Local Initiatives on Productivity, Technology, and Innovation, and for other purposes.

IN THE SENATE OF THE UNITED STATES

APRIL 7 (legislative day, MARCH 30), 1987

Mr. BUMPERS introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

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A BILL

To amend the Stevenson-Wydler Technology Innovation Act of 1980 to establish a Center on State and Local Initiatives on Productivity, Technology, and Innovation, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Competitiveness Enhancement Act of 1987".

SEC. 2. ESTABLISHMENT OF CENTER.

(a) **ESTABLISHMENT.**—The Stevenson-Wydler Technology Innovation Act of 1980 is amended by inserting after section 5 the following new section:

"SEC. 5A. CENTER ON STATE AND LOCAL INITIATIVES ON PRODUCTIVITY, TECHNOLOGY, AND INNOVATION.

"(a) **ESTABLISHMENT.**—There is established in the Office of Productivity, Technology, and Innovation a Center on State and Local Initiatives on Productivity, Technology, and Innovation. The Center shall be headed by a Director for State and Local Initiatives on Productivity, Technology, and Innovation, who shall be appointed by the Secretary. The Director shall report to the Secretary through the Assistant Secretary.

"(b) **CLEARINGHOUSE.**—The Center shall serve as a clearinghouse of information on initiatives by State and local governments to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation. To carry out the preceding sentence, the Director shall—

"(1) establish relationships with State and local governments, and regional and multistate organizations of such governments, which are carrying out such initiatives;

"(2) collect information on the nature, extent, and impact of such initiatives, particularly information useful to State and local governments and small businesses;

"(3) disseminate information collected under paragraph (2) to Congress, Federal agencies, State and local government agencies, and the public;

"(4) publish handbooks and materials concerning methods which may be used by State and local governments to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation; and

"(5) hold public and private conferences and seminars.

"(c) Evaluation of State and Local Initiatives.—(1) The Director shall—

"(A) evaluate the effectiveness of initiatives by State and local governments to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation;

"(B) develop methodologies for the conduct of the evaluations described in subparagraph (A); and

"(C) disseminate information concerning the effectiveness of any initiative evaluated under subparagraph (A) and any methodology developed under subparagraph (B) to Federal agencies, the Congress, State and local governments, and the public.

"(2) The Director may only conduct an evaluation of a State or local initiative under paragraph (1)(A) and disseminate information regarding the effectiveness of any initiative under paragraph (1)(C) if the State or local government carrying out such initiative consents to and cooperates with such evaluation.

"(3) In carrying out subparagraphs (A) and (B) of paragraph (1), the Director may enter into contracts with State and local governments and public and nonprofit entities. Any such contract may provide that a portion of the costs of carrying out such contract will be paid by another Federal agency, a State or local government, or a public or nonprofit private entity, which is a party to such contract.

"(4)(A) The Director shall by regulation require any public or nonprofit private entity which proposes to enter into a contract under paragraph (3), whether by advertising or negotiation, and which under such contract will pay a portion of the costs of carrying out such contract, to provide the Director, prior to entering into any such contract, with all relevant information bearing on whether that entity has a possible conflict of interest with respect to (i) being able to render impartial, technically sound, or objective assistance or advice in light of other interests or relationships with other persons or entities, or (ii) being given an unfair competitive advantage. Such entity shall insure, in accordance with regulations published by the Director, compliance with this paragraph by subcontractors of such entity who are engaged to perform similar services.

"(B) The Director shall not enter into any contract under paragraph (3) unless the Director affirmatively finds after evaluating all such information and any other relevant information otherwise available to the Director, either that (i) there is little or no likelihood that a conflict of interest would exist, or (ii) that such conflict has been avoided after appropriate conditions have been included in such contract. Notwithstanding the preceding sentence, if the Director determines that such conflict of interest exists and that such conflict of interest cannot be avoided by including appropriate conditions in such contract, the Director may enter into such contract if the Director determines that it is in the best interests of the United States to do so and includes appropriate conditions in such contract to mitigate such conflict.

"(C) The Director shall publish rules for the implementation of this paragraph in accordance with section 553 of title 5, United States Code, as soon as possible after the date of enactment of this section but in no event later than 180 days after such date.

"(d) IMPROVEMENTS IN FEDERAL PROGRAMS.—The Director shall—

"(1) study ways in which Federal agencies can use existing policies and programs to assist State and local governments in carrying out initiatives to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation;

"(2) make periodic recommendations to the Secretary through the Assistant Secretary, concerning modifications in such policies and programs which would improve such assistance; and

"(3) convene meetings and conferences of Federal, State, and local officials in order to carry out joint and cooperative initiatives to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation.

"(e) ADVICE AND TECHNICAL ASSISTANCE.—On request of a State or local government, the Director shall—

"(1) advise such government with respect to initiatives undertaken by such government to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation;

"(2) provide technical assistance to such government with respect to such initiatives; and

"(3) assist such government in determining sources of assistance from other Federal agencies which may be available to support such initiatives.

"(f) GENERIC RESEARCH.—The Director shall—

"(1) conduct, or support the conduct of, generic research on—

"(A) the process of stimulating productivity, technology, and innovation; and

"(B) methodologies for the evaluation of initiatives by State and local governments to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation; and

"(2) make the results of such research available to Federal agencies, the Congress, State and local governments, and the public.

"(g) ANNUAL REPORT.—The Director shall prepare and transmit to the Congress an annual report on initiatives by State and local governments to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation. Each report required by this section shall contain—

"(1) a description of such initiatives;

"(2) summaries of evaluations conducted by the Director under subsection (c);

"(3) a description of any research supported by the Director under subsection (f) and of the findings and conclusions of such research; and

"(4) recommendations for activities by Federal agencies to support State and local initiatives to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation.

"(h) FOCUS OF ACTIVITIES.—In carrying out the preceding subsections, the Director shall ensure that activities of the Center focus on—

"(1) State and local initiatives to stimulate the formation of new small businesses, to increase the competitiveness of industries, and to create a favorable climate for entrepreneurs;

"(2) State and local initiatives involving cooperation among government agencies, regional organizations, businesses, labor organizations, and nonprofit institutions;

"(3) State and local initiatives to—

"(A) gather and disseminate information;

"(B) promote research and development;

"(C) foster cooperation between labor and management;

"(D) generate venture capital;

"(E) assist in the development of human resources through technology and innovation;

"(F) organize partnerships among businesses and educational institutions;

"(G) expedite the transfer of technology;

"(H) provide training in entrepreneurship;

"(I) improve management and technical effectiveness of technology; and

"(J) assist in making technology available for commercial use; and

"(4) State and local initiatives to encourage the establishment of flexible, computer-integrated manufacturing systems.

"(i) LIMITATIONS.—(1) The Director shall not—

"(A) provide financial assistance to a State or local government to support the implementation of any initiative to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation, other than any financial assistance which is necessary for the conduct of an evaluation of such an initiative under subsection (c);

"(B) provide financial assistance to support State and local government initiatives to stimulate economic development through the conduct of public works or the repair or replacement of infrastructure;

"(C) provide any assistance to a State or local government in efforts to encourage a private business to locate any facility in a State or local jurisdiction or to relocate any facility from one State or local jurisdiction to another; and

"(D) consider any issue included in a specific labor-management agreement without the consent and cooperation of all parties to the agreement.

"(2) The Director may conduct, or provide for the conduct of, research with respect to matters described in subparagraphs (B) and (C) of paragraph (1).

"(j) REGIONAL OFFICES.—In fiscal year 1989 and each of the succeeding fiscal years, to carry out this section, the Director shall assign professional personnel of the Center to regional officers of the Department of Commerce.

"(k) ADMINISTRATION.—(1) The Secretary shall carry out paragraphs (7) and (8) of section 5(c) through the Director.

"(2) In carrying out this section, the Director—

"(A) shall work closely with other Federal agencies, including the Department of Agriculture, the Department of Defense, the Department of Labor, the National Science Foundation, and the Small Business Administration;

"(B) may, jointly with other Federal agencies, enter into contracts with public and nonprofit private entities; and

"(C) shall work closely with Federal, State, and local agencies responsible for enhancing export opportunities for United States businesses.

"(l) ADVISORY BOARD.—The Director shall establish an advisory board to advise the Assistant Secretary and the Director on the policies, priorities, and activities of the Center. The advisory board shall include a broad range of members, including officers of State and local governments, leaders in business and labor, and experts on productivity, technology, and innovation. The advisory board may make recommendations to the Assistant Secretary, the Director, and the Congress concerning ways in which Federal agencies can use existing policies and programs to assist State and local governments in carrying out initiatives to enhance the competitiveness of American business through the stimulation of productivity, technology, and innovation.

"(m) AUTHORIZATION OF APPROPRIATIONS.—To carry out this section, there are authorized to be appropriated $2,000,000 for fiscal year 1988, $3,000,000 for fiscal year 1989, and $4,000,000 for fiscal year 1990 and each of the succeeding fiscal years. Amounts appropriated under this subsection shall remain available until expended.".

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(b) DEFINITIONS.—Section 4 of such Act is amended by adding at the end thereof the following new paragraphs:

"(13) 'Center' means the Center on State and Local Initiatives on Productivity, Technology, and Innovation established by section 5A.

"(14) 'Director' means the Director for State and Local Initiatives on Productivity, Technology, and Innovation appointed under section 5A(a).".

"(c) REPORTING BY ASSISTANT SECRETARY.—Section 5(b) of such Act is amended by adding at the end thereof the following new sentence: "The Assistant Secretary shall report directly to the Secretary.".

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TESTIMONY OF
CONGRESSMAN RON WYDEN
BEFORE THE
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

APRIL 30, 1987

TESTIMONY
CONGRESSMAN RON WYDEN
APRIL 30, 1987

Mr. Chairman, thank you for giving me the opportunity to discuss the need to expand our nation's technological research efforts in order to improve our nation's competitiveness.

There's no doubt that competitiveness is the buzz word of the 100th Congress. And for good reason -- U.S. manufacturing technology has not fared well recently against foreign competition. One industry after another has fallen to off-shore competitors offering well-made products at low prices. As third world labor costs rise, the quality of a manufactured product will increasingly determine its success in the marketplace.

I understand that this subcommittee will soon consider legislation to create a new avenue of federal, state and private sector cooperation through the establishment of an industrial extension service program. I would like to lend my support for this concept at this time and share with you a program -- that's already in its beginning stages -- that has a similar cooperative structure.

Welding and joining are among the least understood and appreciated aspects of manufacturing. Many people think of welding as something you can learn in a school that advertises on the back of a matchbook. Yet this technology is a critical factor in product quality. Forty per cent of all manufactured goods in the market today have welding as a primary component of production: automobiles, jet aircraft, containment vessels, piping and dozens of other products ranging from simple household pots to our most advanced weaponry. Likewise, the failure of welds is the most common fault of manufactured goods, bridges, and pipelines. And yet the U.S. government has done little to develop advanced welding technology or transfer those technologies to American industry.

Great Britain, the Soviet Union, East Germany, and Japan, have spent tremendous amounts of money on research and development of this critical technology. As a first step toward providing a national center in this country, two institutions -- the Oregon Graduate Center in Beaverton, Oregon and the Edison Welding Institute in Columbus, Ohio -- have joined forces with 167 American companies -- representing every region of this country -- to launch this nation's first welding technology and development effort. This unique partnership is working to create a national welding technology center that is closely linked to industrial needs. The center will provide engineers and materials scientists with educational opportunities in order to directly transfer new technology to American industry.

This enterprise is in the early stages, and, as yet, the federal government has not played a role. This has limited the ability of these institutions to aggressively establish a truly national program -- and there are no other efforts like this in the United States at this time. The opportunity now exists for a small -- but significant -- federal role.

With a small, financial boost from the federal government, the Oregon Graduate Center and the Edison Welding Institute could complete the expansion of the facilities in both Oregon and Ohio, as well as seed at least one new regional welding technology center at an American research university. In addition, a national educational curriculum would be established so that practicing engineers would be able to share their knowledge with manufacturing firms.

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CONGRESSMAN RON WYDEN
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After three years of operation, federal funds would be completely phased out and the full responsibility for funding the national welding technology center would fall to those industries that directly benefit from its work.

In my view, it's this type of partnership, combining state and federal dollars with private sector resources, that can put our nation back on the fast track to regain its competitive edge in the global marketplace. It is my hope that the committee authorize this program, as well as other technology centers that follow this model of combined effort, in its amendments.

Thank you again, for allowing me this opportunity to discuss this issue.

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Mr. **Boehlert**. Thank you, Mr. Chairman.

I am looking particularly forward to today's competitiveness hearing because we're going to have a chance to examine some ways we can build on innovative state programs.

Throughout our review of competitiveness this year, in almost every discussion, whatever the specific topic, whatever our specific questions, our expert witnesses have volunteered the same two observations again and again:

First, the real innovations in technology policy are happening, and should happen, at the same, not the national, level.

Second, successful technology transfer requires direct, regular, one-on-one human contact. As Dr. Robert Pry testified before us last month, technology transfer is a contact sport.

These conclusions shouldn't surprise us. They have been made repeatedly over the years in all those ignored reports that have saved untold jobs at paper mills.

In 1971, for example, a report by the National Governors' Association stated, and I quote, "An examination of experience under the State Technical Services Act of 1965 shows that field service programs were most effective in solving problems." A year or so earlier a study of the same law by Arthur D. Little, Inc. recommended that "field services which are oriented towards problem-solving should receive increasing emphasis through increased budgets and more personnel."

Congress ignored those conclusions, allowed the State Technical Services Act to expire, and many state programs died with it.

But there's been a rebirth of interest in such technology transfer programs in recent years, and this time the states are leading the way. Using the time-honored model of agricultural extension, numerous states are moving to create industrial extension services.

Instead of casting about for expensive untried remedies for our economic ills, instead of establishing gargantuan federal agencies that only reinforce industry's lethargy, we ought to build on those state programs to revitalize our economy.

President Frank Rhodes of Cornell University, who will testify later this morning, has championed this idea, and I plan to introduce legislation with my colleague, Congressman Buddy MacKay, in the next week or so that would provide technical and financial assistance to state industrial extension programs.

The Federal Government has a definite interest in seeing these state programs succeed. They represent the best possible method of ensuring that the results of federal, and federally funded, research are applied by small and medium-sized businesses. And that's the key to our future prosperity.

All the federal technology transfer programs in the world, all of the Executive Orders, such as the fine one our distinguished witnesses will discuss this morning, will be stymied if we don't work with state and local governments.

The form of our bill is still fluid, and I'm eager to hear suggestions on how precisely to take advantage of state efforts. But the principle upon which the bill is based is solid—federal, state and local governments must work together to help revitalize our economy.

This is simply an old idea whose time has come. Or as T.S. Eliot once wrote on weightier matters, "And the end of all our exploring/Will be to arrive here we started/And know the place for the first time."

Thank you, Mr. Chairman.

Mr. **Walgren**. Thank you, Mr. Boehlert.

That proposal is going to have the direct attention of this subcommittee. It certainly is moving in areas where there has been traditional recognition of the legitimacy of the federal role as well. Certainly it will be a great help in developing the kind of broad agreement necessary to come to a successful conclusion in this Congress. So we are looking forward to working with you on that.

We have a call to vote. I particularly regret that because we have been so delayed, but I think we should respond to it. I had wondered whether we might have the time to take your oral statement, Dr. Graham, but there isn't enough time. So with apologies for how inefficient our system is, let's suspend for 10 minutes.

[Recess.]

Mr. **Walgren**. Well, let us begin.

Yes, sir. Are we all set?

Our first witness then will be Dr. Graham, the Director of the Office of Science and Technology Policy.

Your written statement, Dr. Graham, will be incorporated in the record that we make for these hearings, and for the use of all who are interested in it. You may feel free to diverge from your submission in any way that you feel would underscore and highlight the points that you would like to emphasize. So welcome to the Committee. We are pleased you are here.

STATEMENT OF DR. WILLIAM R. GRAHAM, SCIENCE ADVISER TO THE PRESIDENT, AND DIRECTOR OF THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY, EXECUTIVE OFFICE OF THE PRESIDENT

Dr. **Graham**. Thank you very much, Mr. Chairman, Members of the Committee.

It is certainly a pleasure to appear before you to discuss Executive Order 12591, entitled "Facilitating Access to Science and Technology," an Executive Order released by President Reagan on April 10 of this year.

The Office of Science and Technology Policy, OSTP, as we call it, the Office of Management and Budget, and the Economic Policy Council, have all worked with executive agencies to assist the President in formulating this Executive Order.

While the competitiveness issue has emerged as a major new policy thrust, both at home and abroad, the Reagan Administration has long recognized the critical import of the nation's ability to compete in an increasingly global marketplace.

According to the report of the President's Commission on Industrial Competitiveness, issued in 1985, and I quote:

> Competitiveness is the degree to which a nation can, under free and fair market conditions, produce goods and services that meet the test of international markets, while simultaneously maintaining or expanding the real income of its citizens.

While noting that America's ability to compete in world markets was eroding and increases in our productivity and commitment to high quality production had declined relative to other nations, the commission strongly reaffirmed that America's most valuable long term asset in the high stakes competitiveness game is our unparalleled science and technology enterprise. And, I might add, the men and women who make the substance of that high technology enterprise, the educated and skilled and dedicated work force that we have in this country in advanced science, as in other areas.

Since World War II, America's great reservoir of talented scientists and engineers have set the pace in world class scientific discoveries and technological innovations that have fueled our nation's economic prosperity, guaranteed our national security and vastly improved the quality of life throughout the world.

Yet while applauding this achievement, the commission stressed that we cannot take this national treasure for granted, and we cannot become complacent, but rather we must strive to maintain and enhance this key competitive advantage and continually upgrade and strengthen our national commitment to science and technology.

President Reagan has long been the strongest advocate of that view, and has made sustained support of science and technology a cornerstone of this Administration's policies. During his tenure to date, we have witnessed a major expansion in our national investment in science and technology, and a firm recognition that the primary role of government is to support basic research at our universities and our national laboratories, and that the role of industry in our private sector is primarily to translate new knowledge to innovative technologies and to bring high quality products to the global marketplace to benefit both our producers and our consumers.

I highlight these well-known points today to underscore the continuity of this administration's policies in science and technology, and to emphasize that the President's competitiveness issue in science and technology marks not only the culmination of earlier years of work, but most importantly, a redoubling of our national commitment to science and technology and the promise that it holds for the future of our Nation.

Now let me turn to the specifics of the competitiveness initiative, and then discuss some of the key features in Executive Order 12591, including actions now underway in the Executive Branch to implement the order's directives.

The intent to issue the Executive Order was announced by the President in his Quest for Excellence legislation message sent to Congress on January 27th, 1987, along with his State of the Union. In this message, the President outlined a broad goal to commence a new quest for excellence to produce the third great American century. Therein the President spelled out how the nation could prepare for the challenges of the future and seize opportunities to expand our standard of living and maintain our national security. He challenged business, labor, educators, and families to strive for excellence, to attain competitive preeminence and, in so doing, he promised that the government would play a strong role in revitalizing the nation through a six-part initiative aimed at, first, increasing investment in human capital; second, in protecting intellectual property, one of the fruits of that capital; third, in enacting essential legal and regulatory reforms; fourth, in shaping the international economic environment, so much with us today; fifth, in eliminating the budget deficit; and sixth, in promoting the development of science and technology.

Yet, as the President pointed out, no government plan or program is capable of enacting such sweeping change in reform. All of the federal spending in the land cannot buy excellence. It must occur as a part of the natural instinct of free people to compete for the highest standard.

In addressing the science and technology component of his competitiveness initiative, the President stated that our nation's science and technology policy must serve three broad objectives:

First, generating new knowledge in the science and advanced technologies; second, swiftly transferring technologies to American industry, who will then take it to the marketplace; and third, expanding the nation's talent base in science and technology fields.

To meet these national objectives, the President announced a number of bold measures to breathe substance and depth into his initiative, including doubling the budgetary commitment to the National Science Foundation's program over a five-year period—that on top of a more than 50 percent increase in the NSF budget since the beginning of this decade; establishing a number of new government-private science and technology centers, based at U.S. universities. And these centers, like the engineering research centers I will describe in a moment, will draw very heavily upon initiative, the leadership and the cooperation of the universities themselves, private industry, and the state and regional governments which support those activities; third, initiating a technology share in a people-to-people exchange program.

And the President announced his intention to issue an Executive Order to facilitate access to science and technology to ensure that federal agencies and laboratories assist universities and private sector in broadening our technology base by moving new knowledge from the research laboratory into the development of new products and processes; something this country has done very well in the past, something some of our foreign competitors are doing in some areas even better today, and something that we must certainly emphasize in the future.

The President has vested implementing responsibilities for specific actions in a number of departments and agencies. As the Director of Office of Science and Technology Policy, I have been directed to convene an interagency task force to report to the President on the progress and problems with technology transfer from the Federal laboratories. My staff and I will be working closely with relevant agencies to assist them in fulfilling their responsibilities, and to monitor their progress.

Toward that end, I would like to highlight three problems addressed in the Executive Order that are a particular priority to OSTP.

These are the basic science and technology centers that I just mentioned; technology transfer from federal laboratories to the private sector; and international science and technology and policy associated with that.

As you know, the concept of basic science and technology centers, established with significant participation from U.S. universities, government, including local and state government, and industry, builds upon the interdisciplinary approach to research first demonstrated in practice by the National Science Foundation's engineering research centers. The engineering research center initiative arose from OSTP and from the National Science Foundation in the early 1980s, based on our shared premise that joint university-industry programs that foster cross disciplinary exchange and forge new institutional linkages stimulate creative research environments and promote the most effective and long last technology transfer.

The climate of cooperation and exchange of ideas engendered by these interdisciplinary centers will advance our program in the forefront areas that transcend traditional disciplinary boundaries, and at the same time expedite the timely transfer of innovation and technology to the private sector.

The Executive Order encourages other agencies and departments to draw upon and to adapt and adopt the ERC model—that is the engineering research center model—to establish interdisciplinary science and technology centers to advance their respective missions. In particular, NASA, the Department of Energy, the Department of Commerce, Defense, and the National Institute of Health are agencies well suited to adopt the science and technology center concept and make a long-term contribution to technological innovation in areas of great significance to the nation's economic competitiveness.

Accordingly, I am requesting that each agency head establish a reporting procedure to provide an assessment of ongoing programs compatible with these programs proposed in future budgets, which I will use for reporting progress to the President.

Concerning technology transfer from Federal laboratories to the private sector, the Federal Technology Transfer Act of 1986 marks a milestone in the Administration's efforts to help shape an environment conducive to research innovation, and the swift translation of new discoveries into commercially viable and competitive products, and the Congress is to be greatly praised for passing that act.

The act also recognizes the inherent economic value of federally sponsored basic research and enables our Federal laboratory directors to control foreign access to these great national scientific assets on the basis of equity and reciprocal access.

The Executive Order builds upon the Technology Transfer Act of 1986, and directs executive agency and department heads to stimulate collaborative activities among Federal laboratories, State and local governments, universities and the private sector, to assist in the transfer of technology to the marketplace, and to delegate authority to laboratory directors to manage intellectual property, patent rights, and license arrangements to promote commercialization.

As science advisor to the President, I will be working closely with the laboratories and senior leadership in Washington to facilitate implementation of the Executive Order.

One area that requires further attention is the role of the government contractors at Federal laboratories, and how we should balance the contractor's responsibilities to their government mission and still provide the latitude needed for the laboratories to make contributions to private sector and the economy at large, and to draw upon their research to do so.

To address that issue and other related concerns, OSTP will convene an interagency task force comprised of the heads of agencies and the directors of representative Federal laboratories to share information about effective mechanisms for technology transfer, and develop initiatives to take advantage of new technologies as rapidly as possible, with emphasis on breakthrough areas, such as high temperature superconductivity.

We will identify creative approaches to technology transfer, such as those that are being developed by the State and local governments, by the Federal laboratories themselves, and the universities, and report progress and problems to the President.

Specifically the report will include a listing of current technology transfer programs, and an assessment of their effectiveness, identification of new and creative approaches for technology transfer to serve as models for all; criteria to assess the effectiveness and impact on the nation's economy of planned and future technology transfer efforts; a compilation and evaluation of the technology share programs and related cooperative research and development venture programs.

Pursuant to my responsibilities in this area, I recently requested the White House Science Council to review the draft Executive Order. The council, interestingly enough, has two former heads of national laboratories on it, as well as a former senior official of a previous administration who had responsibility over several national agency laboratories.

The council recommended a more distributed authority for negotiating the disposition of intellectual property and for establishing collaborative research agreements. In the White House Science Council's view, private industry, universities, and State governments would be more likely to seek research products from federal laboratories if they knew they could negotiate directly with the local laboratory management the rights to intellectual property.

That issue is one that we will certainly address and explore more fully in our interagency task force, and one which, I might add, several of the agencies of the government are already pursuing quite vigorously with a diversity of approaches appropriate to their own missions.

As many of you are aware, right now we are faced with a recent breakthrough in superconductivity accomplished in substantial part by fairly supportive researchers. Work that has profound commercial implications, in my view.

I am pleased to report that the Executive Office is providing the leadership for a multi-agency effort to facilitate the transfer of this research from our laboratories to our private sector—that is, our industrial corporations.

The Office of Science and Technology Policy is organizing a significant meeting in Washington this summer, and we are doing this in cooperation with the Department of Energy and other agencies and various industrial and professional groups. We are organizing it with representatives from academia, Federal laboratories, and American industry, to assess our commercial opportunities and to accelerate the progress of technology transfer.

I have noted the remarks in the Congressional Record, in particular those by Mr. Ritter, Mr. Durenberger, and Mr. Gore, about the superconductivity discoveries and the initiative of Japan's Ministry of Trade and Industry to commence a government study on commercial applications for new superconductivity materials. None of us in government or industry should rest until American breakthroughs in the laboratory have created American breakthroughs in the marketplace.

Final topic I will mention briefly is international science and technology, because it ties into our technical transfer activities and our activities in our federal laboratories.

The international dimension of science and technology is of direct relevance to the United States leadership in science and technology, and to our ability to maintain a competitive position in high technology products in the world marketplace. Since World War II, the United States research establishment has been open to foreign scientists and engineers, and today we continue to be the primary providers of science and technology education and advanced training for foreign students. There are well over 300,000 foreign students studying at American universities, many of whom are supported by the U.S. taxpayer.

The output of our basic research enterprise is widely available and disseminated to the world's scientific community and both our government and private sector has developed an extensive network of international agreements in science and technology that provide foreign researchers with access to American state-of-the-art research facilities and our world class researchers.

Countries such as Japan have benefitted tremendously from their free access to the U.S. research and development system and they view continued access to our basic research output and to our centers of excellence essential to sustaining their competitiveness in high technology industries on which their export driven economies depend.

Recognizing the importance of science and technology development and accomplishment outside the U.S. to America's competitive interests, this Executive Order directs that the Executive Branch will take a number of actions to ensure that the United States will benefit from and fully exploit scientific research and technology developed abroad and will establish equitable two way relationships in science and technology with our foreign partners.

Specifically, the executive order directs the Secretary of State to develop a vigorous recruitment policy for staffing science and technology positions at U.S. embassies abroad with qualified scientists and engineers from government, academia and industry.

My staff will be working with the State Department and the National Science Foundation to develop competitive job criteria, application procedures, selection procedures, and advertising for this new recruitment policy that will enable us to better serve our national science and technology interests overseas.

That's only one example of the things we are doing in the international order.

The executive order will facilitate the President's policy to secure equitable cooperation and reciprocal access to science-related activities and technology with foreign countries by directing federal agencies and departments to consult with the Office of the Trade Representative before concluding international S&T agreements and other arrangements, the purpose being to assess the trade and commercially related impact of the agreements.

Moreover, adequate protection of intellectual property rights and adequate measures to prevent the transfer of strategic technology are two priority areas that must be addressed before the United States concludes further international S&T agreements with foreign governments.

Since January, my office, in cooperation with the State Department, has begun to implement these key provisions in existing science and technology agreements that are up for renewal. We are in the process of negotiating new umbrella annexes on intellectual property and patent rights in the presidential science and technology agreement with Japan and with the government to government agreement with Korea. We will soon begin discussions with China to include a comprehensive intellectual property annex to that bilateral umbrella science and technology agreement.

I will be leading the U.S. delegation to the bilateral joint commission on science and technology that we have with China, that will be taking place in the first half of June.

Ensuring reciprocity in both the contribution and access to basic research with our foreign associates will balance the opportunity of benefit for trade and long term competitiveness that we derive from intellectual and financial investment that our nation makes so generously.

Mr. Chairman, that concludes my statement. I'd be pleased to respond to your questions.

[The prepared statement of Dr. William R. Graham follows:]

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PROPOSED STATEMENT OF DR. WILLIAM R. GRAHAM
SCIENCE ADVISOR TO THE PRESIDENT, AND
DIRECTOR OF THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY
EXECUTIVE OFFICE OF THE PRESIDENT
BEFORE THE
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY OF THE
SCIENCE, SPACE AND TECHNOLOGY COMMITTEE
UNITED STATES HOUSE OF REPRESENTATIVES

WASHINGTON, D.C.
APRIL 30, 1987

Mr. Chairman and Members of the Committee:

It is a pleasure to appear before you today to discuss Executive Order 12591, "Facilitating Access to Science and Technology," released by President Reagan on April 10, 1987. The Office of Science and Technology Policy (OSTP), the Office of Management and Budget (OMB), and the Economic Policy Council (EPC) have worked with the executive agencies to assist the President in formulating the Executive Order.

The intent to issue the Executive Order was announced by the President in his competitiveness initiative, "A QUEST FOR EXCELLENCE," which was sent to the Congress on January 27, 1987.

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In that message, the President outlined a broad goal to renew the American spirit; to commence A NEW QUEST FOR EXCELLENCE that will produce the third great American century. He spelled out how the nation could prepare for the competitive challenges and opportunities to maintain and expand our standard of living and our national security. He challenged business, labor, families, and educators to strive for excellence in order to assure competitive preeminence.

The President promised that the Federal Government would play a strong role in the process of revitalization through a six-part program aimed at:

1. Increasing investment in human capital;
2. Protecting intellectual property;
3. Enacting essential legal and regulatory reforms;
4. Shaping the international economic environment;
5. Eliminating the budget deficit; and
6. Promoting the development of science and technology.

But, as the President pointed out, "no government plan or program is capable of enacting such sweeping change and reform. All of the federal spending in the land cannot buy excellence. It must occur as part of the natural instinct of free people to compete for the highest standard."

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The President noted that the new science and technology strategies would serve three broad objectives:

1. Generating new knowledge in the sciences and advanced technologies;
2. Swiftly transferring technologies to the marketplace; and
3. Expanding the nation's talent base in science and technology fields.

He announced a number of measures to meet these objectives including:

1. Doubling over five years the budget of the National Science Foundation;
2. Establishing a number of new government-private "science and technology centers" based at U.S. universities;
3. Initiating a "technology share" and a "people-to-people exchange" program.

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And he promised to issue an Executive Order which would:

- Encourage scientists working in federal laboratories to commercialize their research by requiring federal agencies to implement royalty sharing programs with federal inventors;

- Promote technology transfer and commercial spin-offs from federal research and development efforts by requiring federal agencies and federally-operated laboratories to seek out "science entrepreneurs" to act as conduits between the laboratories and business, venture capitalists, and universities;

- Fully exploit foreign science and technology by requiring the Department of State to develop a vigorous recruitment policy that encourages scientists and engineers from other Federal agencies, academia, and industry to apply for assignment in U.S. Embassies abroad; and

- Ensure that industry and academia benefit from research and technology abroad by requiring the Departments of State and Commerce and the National Science Foundation to develop a central mechanism to ensure that this information is made available in a prompt and efficient manner.

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He also promised that he would implement a policy permitting federal contractors to own software, engineering drawings, and other technical data generated by federal grants and contracts in exchange for royalty-free use by the government.

Executive Order 12591 addresses all of these issues.

I would like to remind you, however, that unlike public laws established by Congress and approved by the President, Executive Orders do not carry the same degree of enforceability. They are not written to the same careful specifications and are not intended to be interpreted strictly in a court of law.

Rather they set a tone for the Administration; they convey to agencies and federal employees a sense about how programs and activities should be carried out. In this regard, therefore, they depend upon individuals to see that they are implemented effectively.

Because I am one of the individuals who is charged with implementing this Executive Order, I want to tell you about my commitment to the technology transfer process and steps I have taken to provide access to federally supported science and technology.

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Senior Policy Analyst for Technology Transfer:

For several years the Industrial Research Institute has supported a Senior Policy Analyst for a one-year appointment at OSTP. This year that person is Dr. Fred Leavitt who was previously a Vice President for the Dow Chemical Corporation. Dr. Leavitt has considerable experience in transferring technology from a corporate research laboratory setting to the product line. Earlier this year I asked Dr. Leavitt to concentrate his efforts on new mechanisms for technology transfer from our federal laboratories to the private sector and to report directly to me. The previous IRI fellow at OSTP, Lee Rivers, has recently accepted the position of Director of the Federal Laboratory Consortium for Technology Transfer which was created by the Federal Technology Transfer Act of 1986 (PL 99-502).

Superconductivity Conferences:

Many of you are aware of the recent breakthrough in superconductivity by federally supported researchers which has led to a "Woodstock" of enthusiasm by world scientists. I have noted remarks in the Congressional record (in particular by Mr. Ritter, Mr. Durenberger, and Mr. Gore) about the

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subject and the initiative by Japan's Ministry of Trade and Industry to begin a government coordinated "study" involving university and industry representatives (including some of Japan's electronic giants) to find commercial applications for the new superconducting materials. You should know that my staff is now developing plans for a significant meeting here in Washington this summer with representatives from academia, federal laboratories, and American industry to begin assessing our commercial opportunities. I feel that when such opportunities arise, the Executive Office should provide leadership for multiagency participation and for bringing the research out of the federal laboratories to our private high technology corporations.

Science and Technology Centers:

The concept of Engineering Research Centers arose from OSTP and NSF in the early 1980s, and we have continued to be interested in fostering joint university/industry research programs which promote such people-to-people interactions (the most effective kind of technology transfer). For FY 88 you will note that the NSF request contains not only increased funds for the ERCs but also an expanded program involving the more basic sciences and other NSF directorates to support Science and Technology Centers.

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You will note that Section 6 of Executive Order 12591 extends this concept by directing the head of each department and agency to examine the potential for including the establishment of basic Science and Technology Centers in their strategy and planning for future research and development programs. We believe that the principle may be expandable to several other mission agencies such as NASA, DOE, DOD, and USDA and NIH in order that they also contribute to the nation's long-term economic competitiveness. I plan to request that each agency head set up a reporting scheme to provide an assessment of current programs that fall under this concept and to provide a regular report of new programs approved as part of future budgets.

Interagency Laboratory Directors:

In order that the various agencies share information about effective mechanisms for technology transfer, OSTP will within one year convene an interagency task force comprising the heads of representative agencies and the directors of representative federal laboratories, or their designees. We will identify creative approaches to technology transfer and report progress and problems directly to the President. Specifically the report will include:

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1. A listing of current technology transfer programs and an assessment of the effectiveness of these programs;

2. Identification of new and creative approaches to technology transfer that might serve as model programs for federal laboratories;

3. Criteria to assess the effectiveness and impact on the nation's economy of planned or future technology transfer efforts; and

4. A compilation and assessment of the technology share program and, where appropriate, related cooperative research and development venture programs.

You will note this item in Section 7 of Executive Order 12591.

REVIEW OF THE EXECUTIVE ORDER:

In order to review Executive Order 12591 from a broad perspective, I requested a review of the final draft by the White House Science Council at its meeting on March 19-20, 1987. As you know, the Council is made up of a previous science advisor, former federal laboratory directors, agency

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heads, university professors, administrators, and corporate officials. That review resulted in a sense of how OSTP should proceed in implementing a more efficient process. Generally speaking, the Council recommended a more distributed authority for negotiating the disposition of intellectual property and for establishing collaborative research agreements. It was agreed that private industry, universities, and state governments would more likely seek research products from federal labs if they knew that they could bargain directly with local authorities for rights to intellectual property. We will, therefore, work toward this end.

Finally, let me assure you that this Executive Order will not affect the applicability of any existing laws or regulation relating to the transfer of United States technology to other nations. The President has specifically excluded from consideration any technology that would be, if transferred, detrimental to the interests of national security.

This concludes my prepared statement, Mr. Chairman. I would be happy to respond to questions.

Mr. Walgren. Thank you very much, Dr. Graham. We certainly appreciate the directions you are going in and the direction the Administration is going in.

I noticed in your statement you indicate you want to be sure to differentiate between an Executive Order and laws. Executive orders don't carry the same degree of enforceability. I think it would be fair to say that perhaps you have a much greater power operating under executive authority than we can through the legislative process because of the degree of consensus that is required before anything becomes law in our country, and yet within the Executive Branch, we see very constructive movements in many of the research programs.

I am thinking of the semiconductor program, which really will do some of the things and lay some of the ground work for actual manufacturing capabilities that we don't seem able to reach through the legislative process.

I want to encourage you to realize the power that lies behind the Executive's ability to act where we are quite limited in the range that we can require action.

Dr. Graham. We certainly won't be bashful in implementing the Executive Order, Mr. Chairman. I appreciate your remarks and I understand them.

Mr. Walgren. Along that line, I would like you to understand some of the frustration of many of us on the Committee, where we have certainly been trying to encourage things to happen. I hope that you will be successful in making them happen. Noting your emphasis on our research centers through universities, private sector and government, your predecessor, Jay Keyworth, developed a program in steel research and development that we have been trying to encourage to happen.

I guess I would like to ask if you see any divergence of that program with the kinds of things that you intend to carry out, and if there is such a divergence, please let me know in some later submission. We have been frustrated with rescissions and deferrals and no funding on a program that really seems to be in the direction that the President and your level of the Executive Branch wants to go in.

Dr. Graham. I'll take that for the record if I may, Mr. Chairman.

[Information to be furnished follows:]

Question. Your predecessor, Jay Keyworth, developed a program in steel research development that we have been trying to encourage. Do you see any divergence of that program with the kinds of things you intend to carry out?

Answer. The Department of Energy is currently supporting a steel research program which involves their laboratories, universities and the steel industry. The activity is being carried out through Argonne National Laboratory in conjunction with the University of Chicago and through Oak Ridge National Laboratory in conjunction with the University of Tennessee.

Mr. Walgren. That brings me to the general question of how can we measure the success in this area? I appreciate in your statement that you say you are going to be forming a task force which will review and the like, but the one thing that stands out about the Executive Order is that it does not direct any measurable increase in effort in these directions.

Can you give us any suggestions on how we will be able to measure the effectiveness of the initiatives that you outlined?

Dr. **Graham**. Well, Mr. Chairman, the Nation has already been very strong in its investment in research and development. The Congress continues to be very strong. The President is proposing about $9 billion for support of basic research and the physical and life sciences for 1988 and a total research and development budget of about $65 billion.

There is a great wealth of resources and capability already in the program. What we would like to do is use that wealth and capability as efficiently as possible to support our commercial enterprise and our economic competitiveness, while at the same time realizing that the government laboratories are constituted for specific missions and we can't divert them from those missions without paying a very heavy price in losing the product of those research efforts.

What we would like to do is have the commercial benefit come in a complimentary way to the missions of the government laboratories for which those laboratories were established.

Two of the ways that I measure the usefulness of that complimentary contribution to our commercial sector is through the commercial sector's willingness to participate in these activities, first in its willingness to help support the research through its own funds, funds such as those that are contributing to the engineering research centers, and we look forward to contributing to the science and technology centers, and second, for industry's participation with an equally scarce resource, that is its best technical talent. We look forward to exchange activities, to bringing private industry employees into the government laboratories, making provision for government laboratory employees to spend some time in private industry.

We look forward to accelerating the technical transfer and really understanding how committed industry is to these activities. Where industry support is strong, we will try to make government support strong. Where industry support isn't strong, if we think they are right, we will back off on those particular activities. If we think they are wrong, we will try to persuade them to increase their support.

Mr. **Walgren**. Let me add as a footnote to that, that we hope the National Bureau of Standards will rise to equal emphasis with any other expanding effort. Certainly, when you measure what they might be drawing presently in terms of industry commitment, they would stand out for this kind of emphasis more than the National Science Foundation would. Although they are not reduced in this budget, they still don't seem to be given the focus that I think an agency so directly encouraging of manufacturing progress would want.

Dr. **Graham**. They certainly over a long sweep of time have been leaders involving industry in their activities and looking to industry for participation and to form this type of complimentary activity that I was describing. I think the total contribution of the National Bureau of Standards has to be measured not only by the government support for the Bureau but also by the industry support, which has been very strong. We will certainly continue to encourage that.

Mr. WALGREN. Let me ask you for another submission that would be something along the lines of going back perhaps to 1970. If you would break out the effort made through the National Science Foundation as a measure of constant effort, constant dollars, and if you could look at that in concert with the principles that you have just set and where you would envision the budget for the Bureau of Standards going in the next several years, given the declining support over the past number of years, and the importance they could play in that area.

Dr. GRAHAM. I'd be pleased to do that, Mr. Chairman.

[Information to be furnished follows:]

Question. Where do you see the budget for the National Bureau of Standards (NBS) going in the next several year, given the declining support over the past years?

Answer. The National Bureau of Standards is in the business of assisting and supporting industry. They transfer to industry the results of research done at their facilities in a number of ways, including having people on company payrolls working at the Bureau. We recognize that the funding for NBS activities has not increased in real terms in recent years. However, the Bureau's Fiscal Year 1988 budget as submitted by the President to Congress, does include a 14 percent increase.

I see a continuing need for strong support of the NBS close working relationship with industry, and I will give this a high priority in future budget considerations.

Mr. WALGREN. Thank you. The Chair recognizes the gentleman from New York, Mr. Boehlert.

Mr. BOEHLERT. Thank you, Mr. Chairman.

Dr. Graham, you were one of the principal players in the development of the President's competitiveness package. Could you explain why there wasn't more emphasis and more attention paid to the National Bureau of Standards?

Dr. GRAHAM. Well, in part, I think it was because it was felt that the National Bureau of Standards was doing a very good job and that we were trying to bring other agencies up to the level and capability in cooperation with industry that the National Bureau of Standards had already in large measure accomplished. In a sense, they are one of the leaders in this activity. We are trying to encourage other parts of the government to move in that direction.

Mr. BOEHLERT. I agree with you on the good job being done at the Bureau. A good job is being done at NSF and they got a lot of attention.

Dr. GRAHAM. It's a newer initiative for NSF, however. The Bureau has been doing it for a long time. Perhaps they have fallen victim to the fact that they are doing such a good job that it tends to be the squeaking wheel that gets more of the grease.

Mr. BOEHLERT. They are doing such a good job; maybe that explains why year after year, up until this year, they have always come in from OMB with a requested budget cut. I wish you would pass the word around down there so the others that you talk with would appreciate what you and I recognize.

You know probably that Congressman MacKay and I are developing a package, Federal Industrial Extension Service Act, that we anticipate introducing shortly and we will be consulting with you at some length.

I am wondering right now, do any Federal agencies provide any technical assistance to state technology transfer programs?

Dr. Graham. I am not sure and I would prefer to take that for the record, because I haven't looked into that in great detail. I think a great deal takes place as a practical matter through the very strong state university system, which derives a great deal of its support in the research area from the Federal Government. As you know, a decision was made somewhat systematically at the end of World War II to vest a great deal of our basic research capability in our university system, both state and private university systems, and while many of those universities have been under the auspices of the States and worked with the state environment, they have certainly been strongly supported by the Federal Government.

That is one mechanism. Training students, doing research, having professors in the local environment. That has created a strong technical transfer environment for the states.

I will look at the history of the subject and see if I can find other examples.

Mr. Boehlert. I would appreciate your sharing with us your findings when you complete that review.

[Information to be furnished follows:]

Question. Do Federal agencies provide technical assistance to state technology transfer programs?

Answer. Federal agencies do provide technical assistance to state technology transfer programs. A notable example is the activities NASA carries out through its Industrial Applications Centers (IACs). The nine IACs have developed bridging relationships with state technical assistance centers in a total of 22 states, and works with those centers to help solve industrial problems using NASA-developed technology.

Mr. Boehlert. Monday we had a hearing and several witnesses said they felt that the Department of Commerce was sort of an inhospitable place for science programs, such as those under the National Bureau of Standards, because they feel that science and technology at the Department of Commerce takes a back seat to trade, which is the subject of the hour incidentally on Capitol Hill.

How would you respond to that observation?

Dr. Graham. I think I can respond in a timely way, Mr. Boehlert. I have just spent ten days traveling with the Secretary of Commerce to four countries on the western rim of the Pacific. I can tell you from firsthand discussions and from his statements that the Secretary of Commerce is an extremely strong supporter of science and technology. He realizes the role that it plays not only in our industrial, commercial and economic development but in the development of our allies around the world. At the same time he recognizes the need for equity and reciprocity in all these relationships that we have with foreign countries.

I'd say we have a friend there.

Mr. Boehlert. One last question. Do you feel that science counselors at strategic points around the world in our embassies would pass the test of adequacy? The reason I say that, so often when we are having a hearing like this and the Chairman and I sit here and look out and observe, we see many visitors from around the globe and quite often we have more interest in the activities of this committee expressed by our friends from Japan than we do from the United States of America. I have often felt that it doesn't work the other way around, we are not doing as good a job as we should in terms of having knowledgeable people in science and technology at key posts around the world, to monitor what is going on in the respective countries.

What are your thoughts on that, Dr. Graham?

Dr. GRAHAM. Well, for several decades, past World War II, there wasn't enough science and technology going on in many foreign countries to warrant substantial effort.

Mr. BOEHLERT. But that has changed dramatically.

Dr. GRAHAM. That was exactly my next statement. We are in a different environment today. It's an environment that we have to adapt to if we are going to succeed. Government doesn't always adapt as rapidly as many of us would like. However, we do have some very competent science and technology attaches or representatives in our embassies overseas now. Some of them have advanced degrees in science; some of them have a great deal of experience in science.

In other embassies and other environments, we have people who are not well versed in science or there are embassies where we have no science and technology representation. That acts as a two way street through that person, by the way.

For example, there is no science and technology representative as such, as a dedicated position, in the Philippines today, yet they are struggling to turn around their economy and they know that even small scale technology is very important to them. They have literate and ambitious people there and they would like to have the technical background to make their economy grow and provide them the political stability a growing economy can sustain.

It's a mixed case today. It's a transition situation. We have to change it to stronger U.S. science and technology representation abroad, both for our own economic benefit and for the benefit of our international relations.

Mr. BOEHLERT. Dr. Graham, I agree with you. As the President's Science Advisor, have you so stated that to the Chief Executive?

Dr. GRAHAM. I certainly have, in fact, it is in the transmission that the President made to the Congress along with the State of the Union Message. The State Department is at this moment formulating a proposal that they will submit to the President and which I will certainly review with other agencies with great care to strengthen that entire process, starting with the job descriptions, with the means of finding qualified people from all sectors, from industry, from the universities, and certainly from the diplomatic corp and other agencies of government.

From having a good impartial review of these people, we can find the most capable people we can for those positions and once we send them out to the field, support them. I try to see every science attache that this country sends out to the field before he goes, and I let him know that he has a strong link not only to the State Department but also to the White House. I met with all the science attaches in the countries I visited. I strongly support that interest. The Department of State knows that and we will be making progress on that in the near future.

Mr. BOEHLERT. Thank you.

Mr. WALGREN. Thank you, Mr. Boehlert. Mr. Smith?

Mr. **SMITH** of Texas. Dr. Graham, you mentioned a statistic a minute ago that I had not heard before, and that was there are 300,000 foreign students in the United States, many of whom are subsidized by the taxpayers who have access to the most recent developments in science and technology. You didn't comment whether you thought that was good or bad, and I would be interested in knowing what you thought about that statistic and why.

Dr. **GRAHAM**. Well, I don't think it in and of itself is either intrinsically good or bad. I think the real issue here is what is the balance and the reciprocity and the contribution we get. In some cases, in countries which are very poor, strong allies but who are struggling to develop their capabilities, it is one way we can support their sustaining democracy and sustaining our alliance. In more advanced countries, countries which are becoming now very rich, which in many cases even have a trade balance adverse to the United States, it seems to me we should look to those countries to provide as much benefit overall in the intellectual areas as they derive from the process. It is only fair to ask them to contribute as much as they obtain from this process. That means placing more American students in their universities, when we can find students willing to go there. That means their conducting basic research to contribute to the world's fund of knowledge in science and technology and it means letting U.S. researchers at all levels, not just our Nobel laureates but our young scientists, engineers, go into their laboratories and their facilities and work with them and learn the things they are exploring.

Mr. **SMITH** of Texas. I think those are all good suggestions. Have any of those suggestions been specifically mandated either by the Executive Office or by your department? Is that a wish list of yours personally or is anything being done in an official way?

Dr. **GRAHAM**. It's certainly my wish list and it's the President's wish list but in addition to that, it's being implemented in the science and technology cooperation agreements that we have, that we are renewing with countries. Japan, in particular, is a country in which we have a presidential level science and technology agreement. We are making those the foundation of our proposal to renew that agreement. I'm going to be very firm on keeping that sense of reciprocity and balance in that agreement.

I went to Japan in early February and met with a number of their ministers and other government officials, along with my delegation, representatives of State, Commerce and the National Science Foundation. We spoke with one voice and we made it clear to them that this was going to be a reciprocal agreement, if it was going to be renewed.

Mr. **SMITH** of Texas. Thank you very much.

Mr. **BROWN** [presiding]. This is the Chairman over here now, Dr. Graham. It's a pleasure to see you here. I want to say that I'm encouraged by the initiatives taken by the Executive Office and by the actions that you have described in your statement. I think they are all very positive.

Unfortunately, as you can well imagine, I don't think they go as far as they should. I want to ask a few questions which will perhaps illustrate that.

We very badly need a strong executive policy guidance for a whole maze of science and technology issues in the government. I think you are aware of that. This Administration has difficulty doing that because of their political philosophy. I think you are to be commended for getting the action that you have described in your statement. You know as well as I do that the overall picture of science and technology funding in this Administration has been badly skewed by an over development of weapons, development, test and evaluation. The actual support of basic research in the Department of Defense has gone down in real terms.

In the civilian sector, the picture is even worse. The ratio of military to civilian R&D is now over 2 to 1 whereas it historically was somewhere closer to a 50/50 balance. Within the civilian sector, the part that has been deprived is not basic research, on which this Administration has been extremely good. Both you and Dr. Keyworth ought to be commended for your emphasis on top quality basic research. But the part that has been neglected is only partially redressed by the initiatives you have taken, our technology based development, technology transfer, the development of a technological information base, using all of our resources to capture what is going on in foreign countries. You have described initiatives to redress that.

The overall picture is not nearly as satisfactory as what I think this country needs. Would you like to respond to that?

Dr. GRAHAM. Yes, Mr. Brown. First, it's a pleasure once again to testify before a fellow engineer.

Mr. BROWN. Thank you.

Dr. GRAHAM. I'd like to agree with you on the basic research, which has been strongly supported by this Administration, but also provide the perspective that in the applied research and development activities, of course, they divide into those which were for military purposes, where there is no direct civilian application for the development. Where the country is necessarily required to conduct the development activities to provide for the national security, and on the other hand, the civilian development activities, which by and large are better carried out by industry, by industry with the advantage of its own judgment of the market and of its capabilities and of its skills.

I would rather see money returned to industry by lower taxes and less governmental burden so that industry can use those funds for its own initiative in applied research, in the developmental activities and those things that will bring products to the marketplace.

We are trying to accomplish that and we are trying to tell industry that they have a serious obligation to do that, both an obligation to themselves, if they are going to stay in business and competition, and an obligation to the country to maintain and increase our standard of living.

Industry has got to take the present situation very seriously. We are no longer in the era of the last forty years. Industry is going to have to become more aggressive, more assertive. It is going to have to go out and find technologies and not wait for the technologies to come to it. That is in fact the reason that we are planning a meeting with U.S. industry this summer on the new superconducting materials, not to describe to them in great detail all of the remarkable scientific advances, but to give them the ideas that people have had so far on the applications of these new materials so they can start working on product development, on the advanced research they will need to support that product development.

We are trying to bring them together. We are trying to provide leadership. They need to make the economic decisions. They have to vote with their dollars and their people if they are going to make progress on this.

Mr. BROWN. That's an excellent defense of the posture of the Administration, Dr. Graham. I think we understand the philosophies inherent here. You cannot expect private industry, no matter how successful or well funded it is, to engage in the policy direction of our national economy. That is not their role, particularly as it involves science and technology.

You described the situation on the superconductor very well. We had testimony yesterday that in Japan, within a matter of hours or days after the breakthrough in superconducting research, they had mobilized under MITI a program of devoting major resources, hundreds of millions of dollars to do what you are going to call a conference on this summer. That's the problem.

Dr. GRAHAM. Mr. Brown, we are in fact devoting substantial resources in the $100 million class in research on these materials. We don't yet understand why they superconduct. When we do, I think the critical temperature is going to get higher and higher and these things are going to be more and more important.

We are making that information available to our industry by every means that we know. Industry bears the responsibility of looking to that technology for its applications. We will let them know what applications have been conceived of so far, but ultimately they are going to have to tell us they have the men and the markets and so on to make that work. We are not going to dictate to them what they should do.

I believe this process is in fact a secret plan for economic success. It's called a free market force. That is what we are trying to use.

Mr. BROWN. The key word today, Dr. Graham, is "cooperation," not "free market force." The free market force, despite all of its vigor and vitality, can't solve the infrastructure and policy problems that we are concerned about in international markets today. The Japanese have a combined program of coordinated national research in all forms of materials as well as superconductors, which have led them already to make breakthroughs in the drawing of wires that can be used in creating magnets with the superconducting materials, and we are still wondering if it can be done.

That's not the way we are going to succeed in competition with the Japanese. We have to recognize that. We have tried to encourage this Administration to have a coordinated materials research and development program and I have yet to see the first result of legislation that we put on the books several years ago.

Dr. GRAHAM. I can help somewhat by telling you that we also have developed a process in one of our national laboratories for fabricating wire out of these materials as well as thin films which will be very important to electronic applications.

The government support is very strong in this area but we are focusing it on the basic science, understanding what is going on. We are trying to make that available through our engineering research centers, our materials centers, our science and technology centers, so that industry has access to it. We are bringing industry people in so they know what is going on.

Ultimately, industry is going to have to manufacture the products and market the products and develop the products that come from this technology. I think we can do better than the Japanese. I think their government makes a lot of mistakes in that area. I think our private enterprise can work in a much more efficient fashion. That is what we are trying to provide the foundation for and the strong motivation for. We have to get our industry to wake up and remember what a tough competitive world is like, and when they do it, I think there will be no stopping them.

Mr. **Brown**. I agree with your emphasis upon the importance of our system's initiative and enterprise, Dr. Graham, but I think you are blindfolding yourself and this Administration by the failure to recognize that there is an additional component that's necessary here, and despite all the laudable initiatives you have described, it is not true that you are in a better position. Your own budget in the White House has been cut substantially. Commerce is not supportive of science and technology. They are not providing the encouragement to the Bureau of Standards or to the several other science oriented activities in the Department. They are being cut.

I don't want to blame that on you or Baldrige. It is probably some obscure person down at OMB that is doing all this. The overall picture is not encouraging.

Dr. **Graham**. I believe that the Bureau of Standard's budget has gone up in the 1988 submission, Mr. Chairman, and I think that is indicative of the overall support we are trying to provide. The support in basic research has gone up over 50 percent in this decade and will continue to go up strongly. We are pushing in that direction. We certainly agree with you, that is a very important area. We are trying to find the balance here between giving enough incentive to industry through its own ability to retain its profits through the tax structure on the one hand and providing the foundations for research, for science and technology on the other, so we have an optimum mix here.

It's a strong policy question. I think we are on the right track.

Mr. **Brown**. Well, actually, you have not done well in either area. You have industries that are going broke: the chip industry, the auto industry, various other industries. You have to find out sooner or later that there is a relationship, there is a reason for that. It's partly due to the issues that you are making this morning, which are inadequate to the total scope of the problem.

The Chairman told me I could dismiss you after I had worked you over a little bit. [Laughter.]

Dr. **Graham**. Could I say one word about the chip industry, because I was following the chip situation around the western rim of the Pacific for the last two weeks. There is absolutely unequivocal evidence that the Japanese, after they signed the agreement to go to a market pricing on chips, continued in Third World markets a total dumping strategy. That is we were not able to find one instance in a survey made in February where the Japanese were not dumping chips that they were selling. That's a situation that neither U.S. industry or any other industry can tolerate and because of that, the President took some very strong and forceful actions against the Japanese, and that is what is being discussed, I would guess, right now with the Prime Minister.

We are not going to let up on that until they have in fact changed their behavior and gone to a real competitive economy in which we think we can compete strongly.

Mr. **Brown**. It may go competitive but they are not going to give up the other targeting strategies that have been so successful.

Thank you very much.

Mr. **Walgren** [presiding]. Thank you, Mr. Brown.

Let me ask, as I understand it, there has been sort of a different approach to patents and copyright materials in the Department of Energy. In some ways because of being able to define things as related to military, because of the military component of the Department of Energy, they have been able to not grant the range of patent rights and copyright rights that other agencies are now in a position to do.

Has that risen to your attention as the President's Science Advisor?

Mr. **Graham**. Yes, Mr. Chairman. Mr. Farrell is going to speak to that at greater length this morning, I believe, and I will defer to him on the specifics. I do believe it is important that we continue—"we" as the White House Office of Science and Technology—continue to work with all departments and in particular the Department of Energy, to make sure that we obtain the greatest benefit possible in our economic competitiveness from the fine work that is done in the laboratories, including the Department of Energy laboratories. They have made great contributions to our civil economy in the past. I think they can make even greater contributions in the future.

We have to realize they also play a very important role in our national security and we have to balance these two possible realms of capability to make the best use of them.

Mr. **Walgren**. I hope that you will watch and follow that like a bloodhound, because it is my understanding, that because of the delays that they have imposed on some of their contractors, that we have Japanese, German and foreign nations actually marketing in this country software that the developer of that software has not yet had the exclusive ability to offer to the American market. Of course, the Japanese and the Germans don't care about exclusivity, because in their own countries, they are orchestrated in such a way that they are going to be the only ones anyway.

There is something very bizarre going on there that is wrong on a very real level.

Dr. **Graham**. In speaking to the leadership of the Department of Energy, it's clear to me they understand that timeliness is as much an issue as the substance and they need to continue to press for the timeliness of the results that their laboratories produce. I'm sure Mr. Farrell will address that further. I think we are lined up in the same direction. Our job now is to implement the procedures that will achieve that timeliness.

Mr. Walgren. You mentioned the international science effort. It has been suggested to me that in our delegations to international science conferences, that often times, our delegations are made up of administrative government types rather than scientists who are capable of appreciating the kinds of papers and discussions that go on at international conferences.

I'd like to direct your attention to that. It may be that someone in your office could look at who is going to these international conferences and make sure that we are not just sending our administrators, because it looks like they ought to go and because we don't want to send a lot of people, and therefore we exclude the people who would have the capability of actually engaging in international scientific exchange.

Dr. Graham. I think that's very important. I would hope in addition to having the scientists working at the bench, that our administrators would, in fact, be skilled scientists and capable of understanding and helping to guide the contribution of the people at the bench and we would have both of them going to conferences.

Mr. Walgren. I hope, too, that somewhere along the line we can cross over this problem of not developing the government's role because somehow it is illegitimate. I noticed in the testimony of the Department of Defense witness yesterday, the written text that was submitted had a statement, at least in this area, the semiconductor business, that government, too, had a legitimate role, but somehow or another that got left out of the presentation.

I think it is pretty clear that we have run into this road block of pointing the finger that government action is somehow being illegitimate. We haven't had much encouragement from the Administration, even on things like the Japanese technical literature effort, which we have passed into law, but over essentially passive resistance, on the basis that somehow or other this didn't have to be done by government.

I hope that you will in your role as the President's Science Advisor, think of that question of legitimacy, although it is a little gratuitous and just from one member. I think one of the greatest damages that has been done by a federal science establishment that is so heavily weighted in terms of the military doing things in science and technology, is that we haven't developed appreciation of the fact that in some way we have to do some of these things together. Therefore, when we really need to rely on a federal science effort, we find ourselves in battle over this legitimacy problem, because we haven't developed public appreciation of the Federal Government as a major player in this area.

Dr. Graham. There are certainly different roles for government and for industry in this country, in our economy and our research, science and technology, but they are strong roles and I think we understand them very well.

As far as providing better insight into foreign literature, part of the basic science and technology presidential level agreement that we are now preparing to re-negotiate with the Japanese for renewal will include a provision for better access to Japanese technical literature and will provide for more U.S. researchers to be able to go into and adapt to Japanese research facilities and to participate in their activities. That would help provide a means of understanding better what is going on in the research activities of Japan and presumably we can use that as a precedent for other advanced countries as well.

We are very concerned about that and are making that one of the principal provisions of our proposal for the renewal of this agreement.

Mr. **Walgren**. Well, I want to encourage you in that. As I'm sure Mr. Brown emphasized. We are behind in the process. We have seen a lot of damage done to the American manufacturing industry that, had we been more farsighted and creative in our involvement, we would be in a better position to protect ourselves now.

We looked in this committee at the language skills in Japanese that we have in our academic system and we found, I think you could literally count on your hands, the number of students who were actually intensively employed in learning the Japanese language so that they could interact with that society on a sophisticated technical level. That is something that we should have seen coming a long time ago but instead, in many ways, it was not in someone's philosophy and we didn't develop it in time to have it now when we need it.

Dr. **Graham**. I share your concern. I am encouraged by some of the signs I see. For example, MIT takes a great interest in Japanese science and technology. Stanford now has a program, first on its own campus in training in Japanese culture and language and not just for liberal arts majors and for language majors but for engineers as well. They have now established a campus at the University of Osaka and they have a one year program as a part of the undergraduate curriculum in which the student first obtains training in the language and customs at Stanford but then in a junior or senior year, spends the entire 12 months in Japan. Half the time at the University of Osaka and half the time being placed, if you will, as an apprentice engineer in Japanese industry.

I think that is a very constructive move and shows a recognition of the importance of their accomplishments to the world economy. I hope other universities will take up similar and imaginative programs to make sure we do have close links to what is going on overseas.

Mr. **Walgren**. Well, I wish you would also look at the amount of effort in the Japanese technical literature. Program. In the Congress, no new money was allocated, and we were only able to redirect something in the range of $500,000, if my memory serves me correctly, in the last year. Because you don't have some of the blocks that we have in our legislative process and you are not having to force somebody to do something, you have the abilities in the executive branch to really do much better than that. I think, by any measure, $500,000 through the Department of Commerce in that area is not getting more than maybe three people in Tokyo or something like that, and that is not a good measure for a country of our size and the needs we have.

Well, let me express my appreciation. Let me recognize the gentleman from North Carolina, Mr. Price.

Mr. **Price**. Thank you, Mr. Chairman. I have no questions.

Mr. **Walgren**. I want to express our appreciation on behalf of the Committee for your coming and talking with us. We want to develop our role in this and we want to support you as you develop your role. Certainly we can help each other and the result will be that the nation will benefit.

Dr. **Graham**. Thank you, Mr. Chairman.

Mr. **Walgren**. Thank you very much, Dr. Graham.

Our next witness is J. Michael Farrell, General Counsel, Department of Energy.

Mr. Farrell, if you would join us, and as I said at the outset, your written statement will be made a part of the record. We appreciate your being here, and if you could, in the interest of time, limit yourself to something in the range of five-plus minutes. Then we would like to talk a little bit about the area that you cover.

Mr. Farrell.

STATEMENT OF J. MICHAEL FARRELL, GENERAL COUNSEL, DEPARTMENT OF ENERGY, WASHINGTON, DC

Mr. **Farrell**. Thank you, very much, Mr. Chairman and Members of the Committee. I am pleased to appear before you today to discuss the Department of Energy's efforts to enhance U.S. competitiveness through our technology transfer program, particularly as these efforts may be affected by recent legislation and the President's Executive Order No. 12591, dated April 10, 1987, entitled, "Facilitating Access to Science and Technology."

The Executive Order was issued to ensure that Federal agencies and laboratories assist in broadening our technological base by transferring our laboratory produced technology to the private sector. Both the Order and the Federal Technology Transfer Act of 1986 were directed at Government-owned and Government-operated laboratories, commonly referred to as GOGOs, rather than Government-owned, contractor-operated laboratories, commonly referred to as GOCOs.

Even though it performs most of its work through contractor-operated laboratories, the Department plans to implement the Order to the extent permitted by law.

The Department of Energy is engaged in a wide range of technology transfer activities resulting in exciting opportunities for U.S. companies. In 1986, approximately 25,000 scientists and engineers performed more than $5 billion in research and development in DOE laboratories.

The knowledge and skills of these scientists, along with our specialized equipment and facilities, represented a significant part of our Nation's science and technology base. Since their origin in the Atomic Energy Commission, our laboratories have been committed to technology transfer in their R&D programs. More than ever before, the resources of the DOE laboratories are available to industry through many channels.

R&D at the DOE laboratories encompasses a broad range of scientific investigation due to the fact that there is hardly a product or process that does not involve the use of energy. Some of the scientific achievements developed in our laboratories have direct application in the energy industries, while others have application in industries throughout the U.S. economy.

DOE's technology transfer program is designed to ensure that the maximum benefit of Federal research and development is realized by industries, universities, and state and local governments while we maintain our general science, energy and defense-related missions.

The selected commercial applications of DOE technologies by the private sector assists in developing the U.S. industrial base.

DOE and its predecessor agencies have significantly transferred technology over the past 40 years. The spin off of technology from our laboratories has resulted in the establishment and advancement of industry wide, as well as sector-specific industries in fields such as science and medicine.

Examples include the nuclear power industry, nuclear medicine, supercomputers and precision engineering. In these areas, DOE either provided the base technologies and techniques required for new industries, or was intimately involved in the private industry in the development of a group of new technology products.

The Department carries out its R&D missions through a system of laboratories, universities and private companies. Technology transfer is integrated within the research and development programs throughout the system. The Department performs this integration in two ways:

First, by sponsoring, in cooperation with industry, long-term, high-risk research efforts that are unlikely to be undertaken by the private sector alone; and second, by facilitating the effective transfer of technology, making the results of research available widely and promptly in the marketplace.

In the remaining time, I would like to briefly address several of the areas of Departmental activity.

As to Bayh-Dole: DOE is implementing the 1980 Bayh-Dole, as amended. We have been amending our contracts with nonprofit operators of DOE labs so as to allow contractors to retain ownership patent rights.

The contracts for Fermi National Laboratory, Princeton Plasma Physics Laboratory, Ames Research Center, and the Solar Energy Research Institute have recently been so amended.

Modified patent and data provisions have also been agreed to in completed negotiations with the Argonne National Laboratory. Similar contract provisions are being negotiated with the contractors for the Lawrence Livermore, Los Alamos, Lawrence Berkeley, and Brookhaven National Laboratories.

As to class waivers: In addition to the requirements of Bayh-Dole, DOE is in the process of drafting broad class waivers that will allow for-profit contractors to retain ownership of patent rights in many cases.

These class waivers will have the effect of making available to the private sector a significant number of inventions developed or to be developed under contracts with DOE.

The Department has issued several class waivers in the past which permit our contractors to retain ownership of patent rights, including those developed at our laboratory facilities.

As to cooperative agreements: DOE has used in the past, and continues to use its existing statutory and regulatory authorities to enter into cooperative agreements and other arrangements with industry, and to use the flexibility of these authorities to negotiate equitable arrangements with third party sponsors regarding ownership and rights in intellectual property.

Strong emphasis in these negotiations has always been placed on commercialization of the technology. An example of these arrangements include the Steel Initiative and the Clean Coal Technology Program.

For example, in the Clean Coal Technology Program, participants have been permitted to elect to retain patent rights, either under the Bayh-Dole Act for small businesses, or on a case-by-case basis for large businesses.

As to patent waivers: Between January 1, 1980, and December 31, 1986, DOE has waived or licensed the patent rights to approximately 40 percent of the patent applications resulting from DOE funding.

During this period, DOE obtained approximately 3,400 patents applications of which approximately 1,360 have been waived or licensed. The waivers were accomplished using for the most part a case-by-case advance and identified invention waivers together with earlier class waivers.

It should be noted that these numbers do not include those patent applications for which nonprofit and small business contractors acquired rights pursuant to the provisions of the Bayh-Dole Act.

As to the royalty sharing for government-employee inventors: In addition to our present statutory requirements, DOE has decided to use the 15 percent royalty sharing provisions of Section 7 of the Federal Technology Transfer Act for Government-employee inventors.

As to intellectual property rights: A final area of developing interests which I would like to mention is contractor rights to intellectual property for jointly funded research and development. Indeed, just last month, DOE established a task force to study the transferring of intellectual property rights and to look at the issues related to liberalizing contractor retention of data developed under DOE cost-shared arrangements. This study is still underway in the Agency.

In conclusion, we are currently reviewing the Executive Order to determine how best to implement the many aspects addressed therein. The Department will be implementing its various programs and activities as soon as these studies are completed, commensurate with the already demonstrated commitment to technology transfer.

As I have stated previously, the Department continues to support technology transfer as an important objective of the Agency and looks forward to additional successes in the future uses of the new initiatives set forth in the Executive Order.

Thank you, very much, Mr. Chairman. I think that is just a part of my statement, and I would ask that the remainder——

Mr. **Walgren**. Your full statement will be entered in the record.

[The prepared statement of Mr. Farrell follows:]

STATEMENT OF
J. MICHAEL FARRELL
GENERAL COUNSEL
U.S. DEPARTMENT OF ENERGY
BEFORE THE
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
April 30, 1987

TECHNOLOGY TRANSFER

Statement by
J. Michael Farrell
General Counsel
U.S. DEPARTMENT OF ENERGY

to the

Subcommittee on Science, Research and Technology
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U. S. House of Representatives

April 30, 1987

Mr. Chairman and members of the Committee, I am pleased to appear before you today to discuss the Department of Energy's efforts to enhance U.S. competitiveness through our (DOE's) technology transfer program, particularly as these efforts may be affected by recent legislation and the President's Executive Order No. 12591, dated April 10, 1987, for Facilitating Access to Science and Technology. The Executive Order was issued as part of the President's competitiveness initiative and to implement provisions of the Federal Technology Transfer Act of 1986. Both the Order and the Act are directed primarily at Government owned and Government employee operated laboratories (commonly referred to as GOGOs) rather than government owned and contractor operated laboratories (commonly referred to as GOCOs). Even though the Department of Energy performs most of its work through contractor operated laboratories, the Department plans to implement those provisions applicable to GOGOs and, to the extent appropriate within the spirit of the Act and Order, we will implement the same at our contractor operated laboratories.

The Department of Energy has a wide range of technology transfer activities resulting in exciting new opportunities for universities and U.S. companies and new and better technologies for the nation. In 1986, approximately 25,000 scientists and engineers performed more than $5 billion in research and development in DOE laboratories. The knowledge and skills of these scientists and engineers, along with specialized equipment and facilities, represent a significant part of our nation's science and technology base. Since its origin in the Atomic Energy Commission, the Department of Energy and its laboratories have always been committed to technology transfer in their R&D programs. More than ever before the resources of the DOE laboratories are available to universities and industry through a larger variety of channels.

In the course of doing mission research efforts, many commercial spin-off's have occured. For example, DOE is helping teach deaf people to speak, finding ways to diagnose Alzheimer's disease, treating rare forms of cancer and heart disease, and exploring ways to make corrective lenses obsolete through direct reshaping of the cornea. DOE laboratories are helping U.S. companies develop more efficient, less costly ways to make steel; computer manufacturers to produce smaller, more powerful microchips; and engine manufacturers to design and build more efficient, cleaner engines. DOE has developed a gasket to prevent tree roots from clogging sewer lines, found ways to increase the shelf life of fruits and vegetables, and developed new window materials that insulate better than currently used glass windows.

Research at the DOE laboratories encompasses a wide scope of scientific investigation. Though all DOE R&D is firmly rooted in its general science, energy and defense-related missions, there is much opportunity for spin-off into other areas. There is hardly a product or process that does not involve the use of energy. Some scientific achievements have direct application in the energy industry, while others have application in industries throughout the U.S. economy.

DOE's technology transfer program is designed to ensure that the maximum benefit of Federal R&D is realized by industries, universities, and state and local governments while it maintains the scientific mission focus of its R&D laboratories. The selected application of DOE technologies by private companies helps to strengthen the U.S. industrial base.

DOE and its predecessor agencies have made significant science and technology transfers over the past 40 years. The broadest contributions have been in the establishment and advancement of whole industries and fields of science and medicine. Examples include the nuclear power industry, nuclear medicine, supercomputers, and precision engineering. In these areas, DOE either provided the base technologies and techniques required for new industries or was integrally involved with private industry in the development of new technology.

The Department carries out its R&D missions through a system of government laboratories, and contracts with universities and private companies. Technology transfer is integrated within the R&D programs throughout this system.

Technology transfer at DOE takes many forms, providing flexibility to meet industry needs and ensuring that research results can be utilized most effectively. Universities, private companies, and state and local governments are all important partners in DOE's technology transfer efforts. For example, some of DOE's research is in fundamental scientific phenomena and is most appropriately transferred to universities through their participation in large experimental facilities at DOE laboratories. Other research focuses on advanced engineering techniques and is best transferred to private companies through collaborative R&D efforts. Such a broad-based program can provide technology to the nation in the most effective manner.

The Department of Energy laboratories perform basic and applied research and development in three fundamental areas: general science, energy science and technology, and defense-related technology. This R&D is supported by strong capabilities in a variety of disciplines, including physics, biotechnology, chemical sciences, material sciences, geosciences, engineering, and life sciences. Ninety percent of DOE National laboratory funding goes to its nine large, multiprogram national laboratories. The remaining 10% goes to laboratories that specialize in a single program area, such as high-energy physics. Thirty-two of DOE's 36 laboratories are contractor-operated by universities, private companies and nonprofit firms. DOE laboratories operate in a unique environment in which the expertise from numerous scientific and engineering disciplines is applied to complex problems that require a multidisciplinary approach. Similarly, important technology development opportunities often exist as the intersections of several scientific disciplines, requiring integration and synthesis of scientific contributions from many fields. This multidisciplinary approach, which has been successful in meeting our national scientific needs, works for industry through the technology transfer process.

In the past year, DOE and its laboratories have received awards and recognition from national organizations that confirm the significance of DOE's research and technology efforts. In 1986, nine DOE laboratories received IR-100 Awards for developing 21 of the 100 most significant new technical products. These awards are selected by "Research and Development" magazine in an annual competition that recognizes innovators and organizations for outstanding practical technical developments on the basis of their importance, uniqueness, and usefulness. DOE's winning products range from a superprecise engineering lathe that can cut materials to an accuracy hundreds of times finer than a human hair to a small medical kit for "labeling" blood cells with a radioisotope. In the past six years, scientists and engineers at

DOE facilities have received more than 100 IR-100 Awards. Also, in 1986, the Federal Laboratory Consortium (FLC) for Technology Transfer presented 12 Awards of Excellence to employees of DOE laboratories, recognizing uncommon creativity or initiative in the transfer of technology. The chairman of the FLC and four of its six regional coordinators are representatives from DOE laboratories.

The Department offers a variety of technology transfer opportunities for industry and universities. For example, large experimental facilities are available to university and industrial users to perform research on specialized equipment that is often unavailable elsewhere in the United States or the world. More than 200 of these user facilities are available for scientific research at DOE laboratories. During the past five years, industry participation has nearly doubled. In 1986, more than 500 industrial participants representing approximately 200 companies performed experiments on specialized equipment at laboratories throughout the United States. Facilities are available free of cost, provided results are openly published, or proprietary industrial research can be undertaken at private expense. In all cases, full patent rights are retained by the user.

Also currently, some 20 industrial researchers arepart of the Laboratory Industry Technology Exchange Program at DOE multiprogram laboratories. These are cost-shared experiences in technology transfer in which scientists and engineers work at the laboratories for 6 months or more.

A fundamental function of DOE's technology transfer program is also the transfer of scientific knowledge to the university research community. Approximately $360 million is provided to universities as direct support of R&D. Additional funds are provided for operation of contractor user facilities for a total of $800 million of Department resources supporting university research and education each year. These include summer and academic-year research opportunities for more than 3,000 undergraduate and graduate students each year at the laboratories and collaborative research programs and subcontracts between laboratory and university research groups. Each laboratory operates a variety of programs specially tailored for university interactions. For example, Argonne National Laboratory operates 8 programs for visiting faculty, 11 for graduate students, six for undergraduate students, and three for high school teachers and students. Because these programs allow faculty and students to take advantage of facilities and resources not often available at most universities, they aid in the transfer and sharing of scientific knowledge within the research community.

In addition, the unique research capabilities of the DOE laboratories are available to help solve industry's technical problems. Private firms may fund proprietary research at a DOE laboratory when it is compatible with the laboratory's scientific mission and requires its specialized capabilities. In addition, in 1986, over $23 million of R&D was conducted directly for industry by the DOE multiprogram laboratories.

It should be noted that last year, 27 new companies were formed based on technology spinoffs from DOE laboratories, and more than 200 technologies were transferred to existing firms. Many of these startups and transfers occurred because licenses were available from DOE. A large engine manufacturer, for example, signed a license agreement for commercial application of nickel and nickel-iron aluminide alloys developed by Oak Ridge National Laboratory scientists. The broad retention of patent rights by DOE laboratory contractors may provide even more opportunities to stimulate industrial interest in technology developed in DOE.

The Department has also made impressive progress in pursuing collaborative research projects with industry. Last year, 44 collaborative projects totaling more than $16 million were jointly funded representing an industry-government partnership that utilized laboratory resources. Technical collaborations occur through a variety of interactions ranging from informal exchanges to cooperative research and development projects. In one proposed collaborative project, several DOE laboratories will be helping the U.S. steel industry become more competitive by developing advanced techniques for making steel. Current focus is on development of a process for direct steelmaking from ore or scrap iron and development of an electromagnetic continuous casting process. This project uses the combined capabilities of several Federal laboratories and is cost-shared with U.S. steel companies.

The Department is also preparing to initiate cooperative R&D ventures in its Fossil Energy and Conservation/Renewable Energy Programs. These efforts are intended specifically to apply Government sources and technical expertise to new, privately initiated corporate ventures, thereby facilitating the transfer of federally-funded technology or knowledge into a business environment.

These results speak louder than words in demonstrating the Department's continued commitment to improving the industrial competitiveness of the United States through its technology transfer efforts.

The following are a few items of interest in the intellectual property area which also show the level of importance that DOE places on technology transfer and recent legislative enactments.

- DOE is implementing Pub. L. 96-517 (Dole-Bayh), as amended by Pub. L. 98-620 in 1984, by amending contracts with nonprofit operators of DOE labs to allow contractors to retain ownership of patent rights. The contracts for Fermi National Laboratory, Princeton Plasma Physics Laboratory, Ames Research Center and SERI have recently been so amended. The modified patent and data provisions have also been agreed to in completed negotiations for Argonne National Laboratory. Similar contract provisions are being negotiated with the contractors for the Lawrence Livermore, Los Alamos, Lawrence Berkeley and Brookhaven National Laboratories.

- DOE is in the process of drafting broad class waivers that would allow for-profit contractors also to retain ownership of patent rights in many cases. These class waivers will have the effect of making available to the private sector a significant number of inventions made or to be made under contracts with DOE, including our GOCO contractors. DOE has issued several class waivers in the past which permit contractors to retain ownership of patent rights, in many arrangements, including industry use of DOE "GOCO" laboratory facilities.

- DOE has decided to use the 15% royalty sharing provisions of Section 7 of the Federal Technology Transfer Act of 1986 for Government-employee inventors.

- DOE has in the past, and continues even more today, to use its existing statutory and regulatory authorities to enter into cooperative agreements and other arrangements with industry and to use the flexibility of these authorities to negotiate equitable arrangements with third party sponsors regarding ownership and rights in intellectual property. Strong emphasis in these negotiations has always been placed on commercialization of the technology. Examples of these arrangements include the Steel Initiative and Clean Coal Technology Program. In the Clean Coal Technology Program, for example, participants have been able to elect to retain patent rights, either under Dole-Bayh for small businesses, or pursuant to case-by-case advance patent waivers.

- Since 1980, DOE has waived or licensed to others the patent rights to about 40% of all patent applications resulting from DOE funding (i.e., of about 3400 patent applications resulting from DOE funded activities, about 1360 have been waived or licensed). The waivers were accomplished using for the most part case-by-case advance and identified invention waivers, together with some earlier class waivers.

These numbers do not include those patent applications for which nonprofit and small business contractors acquired rights under the authority of the Dole-Bayh Law.

o Indeed, just this last month, DOE has established a task force for Intellectual Property, of which I am the Chairman, to look at issues related to liberalizing contractor retention of data developed under DOE cost-shared arrangements. This study is still underway in the agency.

In addition to these activities, program elements of the Department are currently reviewing the recent Executive Order to determine how best to implement the many aspects addressed by the Order. The Department will be implementing the various programs and activities of the Order as soon as these studies are completed, commensurate with its already demonstrated commitment to technology transfer.

As I have stated previously, the Department continues to support technology transfer as an important objective of the agency and look forward to additional successes in the future using the new initiatives set forth in the Executive Order.

Mr. Walgren. What can be said about this class waiver approach versus the case-by-case waiver approach? We are getting strong statements from people who have been involved with DOE who have not had the benefit of a class waiver, and therefore, as I understand it have had to wait a substantial period of time, which totally distorts the patent process.

Not only would I be right in saying that that requires the inventor to put the money up front, prior to waiver, and many inventors are not able to do that, but at the same time, the patent has been registered—is that correct?—and so it is there for DOE to use for various purposes, but yet not there for the inventor to take to a private commercialization effort.

Mr. Farrell. Mr. Chairman, if I could respond to that, first with a general statement. You have to remember that in DOE-funded contracts, that one of the missions of the Department is National defense, National security. It is a large part. We are the old Atomic Energy Commission; we did come out of the Manhattan Project.

We do have certain defense-related activities. We also have energy research in our other funding projects situations where the patents rights are transferred freely to our contractors. Where you come into problems is where you have the National security aspect of it.

Mr. Walgren. How about if we tried to separate the National security aspect out? There must be a logical way to do that.

Mr. Farrell. We are attempting that, Mr. Walgren. We will be having class waivers coming up. Right now, I think it is about a 13-step process. We do plan on streamlining that down to a level of about a 5-step process.

In other words, we have class examiners, security examiners out in the field. When something comes up, it will be ruled upon either by the security examiner in the field and sent back to DOE headquarters for final review.

Mr. Walgren. It is my understanding that certainly half of the inventions in DOE are not defense or security related, and moreover, that security review is pretty well accomplished within six months. Yet we are still faced with case-by-case waivers taking two years, or thereabouts, or certainly well over six months.

We have received some lists, which just as a random sample are 13 months, 2 years, 15 months, 1 year, 2 years, and it is our understanding that the security clearance should, at best, take six months. There would be no reason for that extra delay.

Mr. Farrell. I appreciate that. Again, Mr. Walgren, if you will note in the regulations that were just issued by the Department of Commerce, final in March, there is in, as it relates to the Bayh-Dole, a provision in there that we do have a six-month time period. If we have not exercised our rights within six months, we lose it.

Mr. Walgren. Now DOE has yet to issue regulations covering that process; is that correct?

Mr. Farrell. That is correct. The Department of Commerce had the lead on that.

Mr. Walgren. How long is it going to be before DOE is in a position to issue responsive regulations?

Mr. Farrell. We hope to have them out within several months. But we are following the regulations—they are mere implementing regulations. We will be following the Department of Commerce regulations to a general degree. We see no problem with them.

Mr. Walgren. Is there any problem with the Department of Energy granting contractors exclusive licenses to copyrighted materials, reserving, as I understand it, only a royalty-free use on or behalf of the Government?

Mr. Farrell. Let me answer it this way: If we are talking just of copyright, is there a problem? No, there is no legal problem. You are talking to the General Counsel.

There is no legal problem in doing that. Where we are running into problems right now is the request for ownership of that data. One of the missions of the Department of Energy is in its research, to get the results of that research out promptly to the general public.

We are a research institute. Everyone should be benefitting from the superconductors we have been talking about, to other situations. What we are running into now, Mr. Chairman, is the situation of joint funding.

If I am a private corporation and am going to put the money up, do I own the data that is coming out of the research? Why would I put up money if all of a sudden something, the data that is generated from that goes out to the general public? That is something to new to us.

There is no legal impediment to us to copyright. We have to look at it, though.

Mr. Walgren. Let me understand. I thought that the structure of the law and the intent that was agreed on was that the inventor would have an exclusive license to take advantage of the incentives that somebody with an exclusive license would have, but we only reserved title and therefore use by the Government on—by or on behalf of the Government. Am I wrong in that?

Mr. Farrell. I am not sure that I followed the track of your question. You have the Atomic Energy Act, the Federal Non-Nuclear Act, the title goes to the Federal Government.

Bayh-Dole, Stevenson-Wydler of 1980 which had mechanisms of getting technology out to the private sector. You have Bayh-Dole amendments of 1984 where we have the small businesses and nonprofits getting title to the patents.

We have the Federal Technology Transfer Act that applies to the GOGOs, not to the GOCOs. I think I have been told we have 36 laboratories; 32 are GOCOs not covered by the Federal Technology Transfer Act. Only four do; 700 employees, $250 million budget.

Mr. Walgren. But you had indicated that responsibility was to get the information out to the general public. Now when you do that, you completely undermine the concept of copyright. If there is a copyright interest that we could get some leverage out of, we are turning our back on that.

I thought that we were intent on providing copyright to copyrightable materials, like software. I thought we were providing a copyright to the inventor except for use on behalf of the Government.

Mr. Farrell. We have the authority to do that. In the National Software Center, run by Argonne, the software goes to that, the information is released to the public generally at that time. You negotiate for software on a case-by-case basis.

Mr. **Walgren**. You have more than authority; do you have an obligation to provide the inventor of copyrightable material a useful copyright, except for the reservation of Government use?

Mr. **Farrell**. Does the Department have a legal obligation? Are we talking legal or moral?

Mr. **Walgren**. Is it in the law?

Mr. **Farrell**. Mr. Chairman, our laws require public dissemination of the data.

Mr. **Walgren**. I see. But in individual contracts you can provide for copyright. Is that the idea?

Mr. **Farrell**. There is no legal prohibition of that. We would negotiate that on a case-by-case basis.

Mr. **Walgren**. In instances where you do provide for the copyright to flow to the inventor or the developer of the copyrightable material.

Mr. **Farrell**. That is correct.

Mr. **Walgren**. You reserve a right for Government use.

Mr. **Farrell**. That is correct.

Mr. **Walgren**. Because we paid for it.

Mr. **Farrell**. That is correct.

Mr. **Walgren**. But now the problem, as I understand it is, that the Government is interpreting that right to go way beyond Government use, and in fact are allowing licenses to copyrighted materials that were under the contract to flow to the inventor, allowing licenses for use of that beyond pure Government consumption, or pure Government use.

Mr. **Farrell**. As the General Counsel, that has not been brought to my attention. We have been more interested at the Department in our mandate to get the information out, to make it public. We are the National Laboratories. We are a resource to the country; to get that information out to the general public.

Mr. **Walgren**. But where you have a contract that provides for the pursuit of a copyright with that inventor, then you don't have an obligation to get that material out to the public. You have an obligation to use it for the Government's purposes, but not get it out there in competing private sector use, in some way.

Mr. **Farrell**. That is correct. If the contract so states, that is absolutely correct, Mr. Chairman.

Mr. **Walgren**. Let me ask how the Department of Energy determines if an invention comes under the National Security Exemptions to the amendments to the patent laws. Do we have a good framework for looking at that with clarity?

Mr. **Farrell**. We have a series of classifications, security, for personnel at all of our facilities, for all of our contractors. They review it, make an initial determination. It comes back to headquarters, comes to my office. We look at it. We have patent examiners look at it and there is a determination made.

If there is no National security concerns, the patent is freely given.

Mr. **Walgren**. How long does that take?

Mr. **Farrell**. We have agreed now it will be six months. It has taken longer; undoubtedly it has taken longer in the past.

Mr. **Walgren**. So there should be no instance, literally, of anything going beyond ten months, or thereabouts, in the resolution of whatever an inventor's relation with the Department of Energy ought to be. Is that a fair statement?

Mr. **Farrell**. Not to a total degree, because you would be negotiating from that point. Let's say in three months you determine, no, there is not. Then you negotiate with the contractor who wants the patent, who thinks it is a patentable process.

You have a situation in some of our facilities now where a process might be determined to be patentable. We have in our contracts allowable cost provisions. Some of the contractors would like to utilize the monies flowing from the contracts for patent application process. That is not an allowable cost.

We would have to amend our regulations. We are in the process of doing that, in the process of negotiating it. But to say six months—all we are doing is making a determination. Then you negotiate, and we hope it does not take six months to determine whether or not there is a National security interest. You would hope it would be quicker than six, or then you lose it.

Mr. **Walgren**. In all those instances there ought to be in the record evidence of the contractor not agreeing to a term offered by the Government. I am trying to get at situations where the Government is just not processing these proposals.

Mr. **Farrell**. If I could answer the question this way, Mr. Walgren. I came onto this job in May 1985. I heard about this situation. I have visited the labs, talked to the patent people, in particular; what were the bottlenecks? We hoped we have cleared those up.

I have personally visited Oak Ridge, Los Alamos, Lawrence Livermore, Albuquerque, Chicago—all of our facilities—discussed this situation and discussed it with patent counsel and made sure these things move. We are keeping a watch on it.

Mr. **Walgren**. As I said to the President's Science Advisor, we are told that there is actually an instance out there where the Japanese and the Europeans are marketing software in our country that the person who has a right to expect a copyright and a license to market that in our country is not yet able to do so because they have not been able to get through DOE's licensing process.

That is a bizarre result, and we ought to be giving that to you in writing and asking you to look at that as a case and make sure that whatever the blocks are, they are not unreasonable and that that kind of circumstance is not replicated.

We will get that to you in writing, and I would appreciate your response.

Mr. **Farrell**. If I could just comment. I have talked to the Secretary about this situation. He is very familiar with some of the allegations that have been made. He fully supports, needless to say, the Executive Order, the applicable laws. He is very concerned about the competitiveness of the U.S. economy and the patent process, and we are working as best we can.

Mr. **Walgren**. Mr. Boehlert.

Mr. **Boehlert**. One quick two-part question. How have DOE labs been working with State technology transfer programs and do you find any of the State technology transfer programs particularly successful?

Mr. **Farrell**. If I could submit that for the record. I am, again, the General Counsel. I don't deal directly with the States. We deal with the major universities. I can get it for the record.

The Assistant Secretary, Fossil Energy (FE), has initiated an aggressive approach to the enhancement of technology research, development, and transfer with the States via Memoranda of Understanding. The Memorandum of Understanding (MOU) is a written agreement which broadly defines basic understandings, and describes a mechanism for coordinating fossil activities to be engaged in by the Department of Energy (DOE) and the participating State. Specific agreements are then developed between DOE/FE and the participating State organization(s) to implement specific agreed to fossil research, development and/or technology transfer activities. These specific agreements are referenced as Annexes to the appropriate MOU's.

At present, three such MOU's have been entered into by DOE/FE. The participating States are Alaska, Illinois, and Indiana. DOE/FE is in the final stages of entering an MOU agreement with Utah, and discussions are underway with Texas, California, Alabama, Virginia, West Virginia, Wyoming, New York and Kentucky.

Under DOE/FE's decentralized program management approach, the implementation of specific projects under the MOU are carried out by the appropriate laboratories. State Technology transfer programs have experienced varying levels of "success", depending on State objectives and priority in objectives. Some of the more generally accepted successes in technology transfer are Ohio, Indiana, Michigan and New York. This is not to say that other State programs have not been as successful, but simply have not been as visible.

Mr. **Boehlert**. That is fine. That is all I have, Mr. Chairman.

Mr. **Walgren**. The Chair will recognize the Gentleman from North Carolina, Mr. Price.

Mr. **Price**. Thank you, very much, Mr. Chairman.

Mr. Farrell, I wonder if you could help me get a little clearer picture of how this process actually works, the soliciting partners in these various enterprises.

Do you have some way of seeking our partners, collaborators? Do you wait to be solicited? Is there something that could be called an outreach program that you have underway?

Mr. **Farrell**. I would have to respond to that for the record. The General Counsel's office does not have an outreach program. You have the National Software Center, you have conferences. We do get the information out as quickly as we can on what we are doing.

The private sector identifies—I know I have contact, if it is not daily, it is every other day, from the Counsel for our contractors on these issues. I just had a meeting of 80 contractor' counsels in Santa Fe, New Mexico last month, talking about these issues. How do you get these things outs? They will keep you informed.

But we are lawyers talking together. I would have to submit exactly how it is done, whether there is an outreach program under energy research, or others. I would have to submit that for the record.

Outreach Program

The Department of Energy has a Department-wide outreach program that is delegated to its laboratories. The focus of this program is to provide opportunities for adoption and use of federally funded technology developments by the private sector and State and local governments. Effective communication that these opportunities are available is essential if new knowledge from the Federal research laboratories is to be applied through development of new products and processes for improved international competitiveness of U.S. industry. These opportunities include numerous kinds of outreach activities, which are: one-to-one direct researcher contact, visitors to the laboratory, technical documents and software, symposia and conferences, patents and patent licensing and assignments, personnel exchanges, cost-shared contracts, grants, advisory groups, user facilities, work for others, and training opportunities. Several of these outreach activities often are used together and therefore are identified as the "technology transfer process." This process can be generically described as people interactions related to scientific and engineering technological accomplishments.

Mr. PRICE. That would be helpful and I would appreciate your doing that.

I wonder how much interest foreign firms have shown in working with DOE labs. Do you have any cooperative arrangements with foreign firms? Does the Executive Order affect such arrangements?

Mr. FARRELL. We do have cooperative arrangements with foreign participation in some of our lab research. We have under fossil, we have joint agreements with Italy and several of the other countries, but, again, I would have to submit that for the record.

The Department of Energy has several international agreements through its laboratories. I have summarized these by laboratory for Sandia National Laboratories (SNL), Los Alamos National Laboratory (LANL), and Lawrence Livermore National Laboratory (LLNL).

For SNL, equal/exchange agreements exist with foreign countries in the following technical fields. For fossil energy, there are agreements with Japan, Germany, Italy, Israel, and Venezuela. In the field of combustion research, there are agreements with Brazil, Japan, England, Italy, France, and Germany. For solar energy, there are agreements with Spain and Israel. For nuclear reactor safety, there are agreements through the Nuclear Regulatory Commission with Germany, Japan, and England. In the field of magnetic fusion material science, there are agreements with West Germany and Japan.

Current LANL examples of cooperative agreements with foreign governments include Mexico Petroleum Research Institute and their nuclear research institute. LANL also has agreeements with Japan, Italy, and Euratom in the area of magnetic fusion energy plus with several Caribbean countries in the area of alternative energy resources. Furthermore, LANL trains nuclear reactor safeguard's inspectors for the IAEA (International Atomic Energy Agency) and develops safeguards instrumentation and techniques for the IAEA. We also have scientific exchange programs with several foreign countries in the area of basic nuclear physics using our Meson Physics Facility. Finally, a recent past example of a cooperative agreement was with Japan and Germany, who cooperated with and supported our hot/dry rock geothermal energy program.

LLNL has an employee exchange agreement with the Philips Research Laboratory, Eindhoven, the Netherlands. Under this agreement, both organizations will benefit from the precision engineering technology of the other. Engineers from the two laboratories will spend one year at the other laboratory. LLNL will gain precision grinding technology from Philips, while Philips will gain some precision matching technology from LLNL. The technologies are important to LLNL programs in precision optics.

LLNL also has a work-for-others agreement with a Brazilian coal company, COPELMI. Under this agreement, COPELMI is funding an LLNL program to assist their efforts in determining the feasibility of in-situ coal gasification in Brazil. DOE and LLNL research in coal-gasification will benefit from results of the effort.

Additionally, LLNL is currently procuring glass for the Nova laser from the Hoya Corporation in Japan. Hoya is also providing glass to the Commissariat a l'Energie Atomique of France with which LLNL has an agreement regarding laser glass research and development.

Now, does the Executive Order affect an existing international agreement?

Mr. PRICE. Yes, would it have any effect on those?

Mr. FARRELL. No, it would not. An Executive Order is not the law of the land. It is an administrative procedure set forth by the President pursuant to the law. So if something is a treaty, or an

Executive Agreement that is in effect now, it would not cancel any previous agreements.

Mr. **Price**. Later today, we are going to hear from the Council on Government Relations, and they will—I don't know if you have seen that testimony, but they will be recommending I understand that the ownership of software and other technical data remain with the contractor; that Government rights be limited to data specifically listed in agreements; and thirdly, that Government rights not interfere with the ability of universities to transfer or commercialize the information.

There, too, you may want to respond for the record, but if you had a chance to look at that testimony and would care to respond, I would be happy to hear your response.

Mr. **Farrell**. I have not seen their testimony. Ownership could hinder the dissemination of information. It is just a cautionary aspect. How long should they own it? Two years, four years? I am not sure. We do have an intellectual property task force. I chair it. These are issues that have come up from the field and from elsewhere.

They are changing the mission of the Department of Energy when you so tie up that type of information. Generally, you really change the mission of the Department, and I am not sure whether that is good or bad. I am not the one to ask.

As a lawyer, I would caution the Congress on that and look at it on a case-by-case basis, not as a general—I certainly would not have legislation to that effect.

With regard to the data rights policy proposed by the Council on Government Relations, our concern is basically that it would be inconsistent with the statutory requirements for dissemination of information which DOE and some other agencies are subject to. I would hope that in enacting any such policy into law, the Congress would reconcile it with existing statutory data rights policies so that agencies do not have conflicting authorities in this area. A policy restricting the dissemination of the results of federally sponsored research would have a major impact on DOE missions and responsibilities.

Mr. **Price**. Well, Mr. Chairman, if we could request answers to these questions, that the record be held open for those. The matter of the outreach programs that DOE has underway, and the question of any impact at all this might have on foreign agreements with foreign firms, and then any further response you would care to submit on the COGR recommendations.

Mr. **Walgren**. Without objection, that will be the order.

Mr. **Price**. Thank you, Mr. Chairman.

Mr. **Walgren**. Mr. Brown.

Mr. **Brown**. No questions.

Mr. **Walgren**. Ms. Schneider.

Miss **Schneider**. I was just looking through the remainder of your testimony. And since you are a lawyer, as you said earlier, I don't have any questions that are particularly directed toward the legal pursuit, that our Chairman had already reviewed with you.

But I just want to state, in case you are in a meeting with the other researchers or folks at DOE, that to say consistently in the testimony of anyone who is representing DOE, that you are doing a great job insofar as energy efficiency research and development is concerned, is I would say not quite accurate.

We have the potential to save $150 billion per year, to save the consumers that amount of money. We know that for every tax dollar that we invest in energy efficiency technology we save $50.

It seems to me that the constant fight that we have to have with the Department of Energy insofar as a budget that reflects the potential of energy efficiency, the fights are ridiculous when we see other nations, our competitors, taking the markets in seven out of ten of the areas where we had hoped to excel—be that in light bulbs, refrigeration, motors, photovoltaics, or whatever.

I just want you to have the record straight from this side of the Congress that in fact it is always a very unpleasant struggle with the Department of Energy to get them to put their money where their mouth is. Their mouth has consistently said through their latest report that energy efficiency is very valuable. They say let the marketplace determine where we will make our investments; we will support the winners and not the losers.

But consistently, they are popping up, the various energy suppliers, that are not the best investment for the dollar. That is the end of my speech.

Thank you for listening. If you have a comment in response, that is fine. I just wanted you to be aware that I, for one as a member of this committee, am very frustrated in how we every year have to fight, and we are fighting right now to get the appropriate money allocated for energy efficiency technology. This is the area where, internationally, we are losing our competitive edge.

I am very saddened to see this because the Secretary of Energy and of the Interior, and many of the people at the National Labs that I have spoken with, are all predicting an energy crisis.

I am very convinced we are going to have one, and I would hate to be in Congress at the time when I am going to have to say—well, we blew it, again. We are up to crisis management, rather than preventive medicine.

Thank you for your indulgence.

Mr. **Walgren**. Thank you.

Let me express our appreciation for your testimony and we will submit some things that we will then get back for the record, and we appreciate your coming.

Mr. **Farrell**. Thank you, very much, Mr. Chairman.

Mr. **Walgren**. Thank you.

With apologies to the fourth panel, if they would permit, we, out of some time constraints that some of the Members have, would like to move to the fifth panel, and promise on our side to be very abbreviated and not impose on your time.

If I could call Richard Geltman, for the Committee on Economic Development and Technical Innovation, from the National Governors' Association; Dr. Frank Rhodes, the President of Cornell University; and Joe Kazmarek, of Impact Technology in Bethlehem. If you folks would come forward, we would appreciate your joining us.

The written statements will be made a part of the record, and the Chair would recognize Mr. Boehlert for an introduction.

Mr. **Boehlert**. It is a pleasure for me, Mr. Chairman, to welcome Dr. Rhodes, from the internationally recognized and acclaimed institution, Cornell University. Dr. Rhodes, it is a pleasure to have you here.

I are very much looking forward to your testimony, as I am to the others on this panel.

Mr. PRICE [presiding]. Mr. Geltman, would you like to proceed?

STATEMENTS OF RICHARD B. GELTMAN, STAFF DIRECTOR, COMMITTEE ON ECONOMIC DEVELOPMENT AND TECHNICAL INNOVATION, NATIONAL GOVERNORS' ASSOCIATION, WASHINGTON, DC; FRANK H.T. RHODES, PRESIDENT, CORNELL UNIVERSITY, ITHACA, NY; AND JOE KAZMAREK, IMPACT TECHNOLOGY, INC., BETHLEHEM, PA

Mr. GELTMAN. Thank you, Mr. Chairman. I appreciate the opportunity for the National Governors' Association to appear before you, to testify today on two proposed bills, the Competitiveness Enhancement Act of 1987, and the Federal Industrial Extension Service Act of 1987.

The Center on State and Local Initiatives on Productivity, Technology and Innovation to be established, pursuant to the Competitiveness Enhancement Act of 1987, is consistent substantively and intergovernmentally with the views of the National Governors' Association, and the National Governors' Association endorses that bill.

State governments have initiated programs to enhance the U.S. competitiveness position. They are experimenting with a variety of tools and techniques and often undertaking the same activities in different circumstances, and to achieve different purposes.

While this experimentation is desirable, there is little evaluation going on at the State level, however, as we described in recent NGA publication, "Revitalizing State Economies." That was a publication that we released at the end of August of this past year.

In NGA's review of State economic development programs, we were unable to determine what types of intervention works best and under what circumstances.

To see if it were possible to develop common evaluation methodologies, NGA just completed a roundtable discussion in conjunction with the National Academy of Sciences. It was apparent from the April 10 meeting that more needs to be known about present State efforts at evaluation, that generic measures for self-assessment for particular types of programs need to be developed, and that more impartial, National evaluations need to be conducted.

The Competitiveness Enhancement Act of 1987 is conceptually sound. It recognizes that States and localities have the primary responsibility for assisting businesses improve their productivity, technology and innovativeness.

States and localities need a clearing house on state and local initiatives to enhance American competitiveness, and it is economic to do this nationally.

States and localities need assistance with conducting evaluations, developing evaluation methodologies and learning of evaluation results.

Federal programs and policies need to complement and support state and local initiatives, and there is a role for an independent

Federal watchdog to recommend improvements in related Federal programs.

The Federal Government can provide advice and technical assistance to State and local governments on how they can improve their own programs.

The Federal Government is the appropriate level of government to conduct and support generic research on the process of stimulating productivity, technology and innovation.

The bill could be improved if the Center were asked to compile and describe information on federal programs from other federal agencies and independent laboratories and disseminate that information to States so that Federal programs could be coordinated to stimulate productivity, technology and innovation. This would really be a second clearinghouse function to that which is proposed in the bill.

The first clearinghouse function is to take a look at what states are doing. The States are very interested in coordinating with the Federal Government. They have a very difficult time assessing what is being done at the Federal level, and if there were one-stop-shopping, so to speak, it would at least provide the States with the opportunity to know what is going on, rather than having to rely on the desperate information sources and the Federal Register, it would be very helpful to them.

Finally, it would be helpful to add to the list of Federal Departments, in Section (k)(2) the Department of Housing and Urban Development. They support a number of the programs and economic development which are useful for technology and technology transfer.

Mr. Chairman, I would be happy to answer any questions.

[The prepared statement of Mr. Geltman follows:]

National Governors' Association

Bill Clinton
Governor of Arkansas
Chairman

Raymond C. Scheppach
Executive Director

TESTIMONY OF

RICHARD B. GELTMAN
STAFF DIRECTOR
COMMITTEE ON ECONOMIC DEVELOPMENT AND
TECHNOLOGICAL INNOVATION
NATIONAL GOVERNORS' ASSOCIATION

before the

SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES

regarding

The Competitiveness Enhancement Act of 1987

and the

Federal Industrial Extension Service Act of 1987

April 30, 1987

HALL OF THE STATES · 444 North Capitol Street · Washington, D.C. 20001-1572 · (202) 624-5300

Mr. Chairman:

I would like to open my remarks by thanking you for inviting a representative of the National Governors' Association to testify before you today on two proposed bills, the "Competitiveness Enhancement Act of 1987" and the "Federal Industrial Extension Service Act of 1987." In my statement this morning, I indicate the "Competitiveness Enhancement Act of 1987" is consistent with NGA's policy, the bill is conceptually sound and meets state needs, and the "Federal Industrial Extension Service Act of 1987" could be merged with the former bill.

The National Governors' Association is keenly concerned that the United States retain its preeminence as the economic leader in the global economy. To assist in achieving that goal Governor Clinton appointed a gubernatorial Task Force on Jobs, Growth, and Competitiveness that will be issuing a report on July 26, 1987, in Traverse City, Michigan. The primary focus will be on what states can do to improve America's competitive position.

The Center on State and Local Initiatives on Productivity, Technology and Innovation to be established pursuant to the "Competitiveness Enhancement Act of 1987" is consistent substantively and intergovernmentally with the views of the National Governors' Association, and NGA endorses the bill.

The United States has long led the world in technological innovation, a major source of strength. Now, however, our nation faces a serious challenge to continued leadership in this area. At home, our technologies have matured and the pace of some new technological innovation has slowed; at the same time, much of our infrastructure and industrial plant equipment is aging. Abroad there is increased competition from emerging as well as established industrialized countries.

To attain and hold the leading position in global competition, American businesses must be technologically sophisticated; managed well; and entrepreneurial. That is firms must be quick to develop and utilize technological advances; firms must be able to blend people, technology and financial resources into flexible, productive operations; and firms must be willing to take carefully calculated potentially high-payoff risks and must have access to adequate financing and technical resources.

State governments have begun to address these imperatives. They are experimenting with a variety of tools and techniques and often undertaking the same activities in different circumstances and to achieve different purposes. While this experimentation is desirable, there is little evaluation going on at the state level, as we described in a recent NGA publication "Revitalizing State Economies." In NGA's review of state economic development programs, we were unable to determine what types of intervention works best and under what circumstances.

To see if it were possible to develop common evaluation methodologies, NGA just completed a roundtable discussion in conjunction with the National Academy of Sciences. It was apparent from the April 10 meeting that more needs to be known about present state efforts at evaluation, that generic measures for self-assessment for particular types of programs need to be developed and that more impartial, national evaluations need to be conducted.

The "Competitiveness Enhancement Act of 1987" is conceptually sound. It recognizes that:

- States and localities have the primary responsibility for assisting businesses improve their productivity, technology and innovativeness.

- States and localities need a clearinghouse on state and local initiatives to enhance American competitiveness, and it is economic to do this nationally.

- States and localities need assistance with conducting evaluations, developing evaluation methodologies and learning of evaluation results.

- Federal programs and policies need to complement and support state and local initiatives, and there is a role for an independent federal watchdog to recommend improvements in related federal programs.

- The federal governmant can provide advice and technical assistance to state and local governments on how they can improve their own programs.

0 The federal government is the appropriate level of government to conduct or support generic research on the process of stimulating productivity, technology, and innovation.

The bill could be improved if the Center were asked to compile and describe information on federal programs from other federal agencies and independent laboratories and disseminate that information to states so that federal and state programs could be coordinated to stimulate productivity, technology, and innovation. It would also be helpful to add to the list of federal departments in subsection (k)(2) the Department of Housing and Urban Development.

The proposed "Federal Industrial Extension Service Act of 1987" is similar to but more limited than the foregoing bill, and could easily be merged with it. It is not clear, however, how the services to be rendered by the Federal Industrial Extension Service Program differ substantially from the present services offered by the National Technical Information Service. In any case, it might make sense to operate the program through the Office of Productivity, Technology and Innovation rather the National Bureau of Standards as proposed.

Mr. Chairman, I would be happy to answer any questions.

100TH CONGRESS
1ST SESSION

H. R. 2492

To establish within the National Bureau of Standards an Office of Extension Services to support, advise, and assist the various State Industrial Extension Services, and to provide for a 3-year pilot grant program to demonstrate methods by which the Federal Government can help States establish, improve, and expand such Services.

IN THE HOUSE OF REPRESENTATIVES

MAY 21, 1987

Mr. BOEHLERT (for himself and Mr. MACKAY) introduced the following bill; which was referred to the Committee on Science, Space, and Technology

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A BILL

To establish within the National Bureau of Standards an Office of Extension Services to support, advise, and assist the various State Industrial Extension Services, and to provide for a 3-year pilot grant program to demonstrate methods by which the Federal Government can help States establish, improve, and expand such Services.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Federal Industrial Extension Act of 1987".

SEC. 2. FINDINGS.

The Congress finds that—

(1) the ability of American industry to compete in the international marketplace is eroding;

(2) greater industrial application of the latest advances in science and technology would help restore American industry's competitiveness;

(3) State programs that work directly with companies to promote the appropriate use of state-of-the-art science and technology have proven to be an effective means of modernizing American companies, particularly small- and medium-sized manufacturers; and

(4) such State programs are an effective means of disseminating the results of federally-funded research.

SEC. 3. PURPOSE.

It is the purpose of this Act to establish a national program to provide technical and financial assistance to the States to enable them to create, improve, or expand their programs of technical services to businesses.

SEC. 4. DEFINITIONS.

As used in this Act—

(1) the term "State Industrial Extension Service" means a State program designed to help businesses, particularly small- and medium-sized businesses, to enhance their competitiveness through the application of

the latest science and technology, utilizing for this purpose—

(A) extension agents who work with specific companies to improve their operations,

(B) workshops and seminars to disseminate scientific, managerial, and technical information, and

(C) other methods of working directly with businesses to enable them to adapt science and technology to their operations; and

(2) the term "Secretary" means the Secretary of Commerce.

SEC. 5. ESTABLISHMENT OF EXTENSION OFFICE.

There is hereby established within the National Bureau of Standards an Office of Extension Services, which shall support, advise, and assist State Industrial Extension Services by—

(1) working with the Federal Laboratory Consortium, the National Technical Information Service, the National Science Foundation, the Office of Productivity, Technology, and Innovation, the Small Business Administration, and other Federal agencies to ensure that State Industrial Extension Services have information about Federal research and development programs;

(2) helping States increase technology transfer by applying lessons learned in other Federal and State programs;

(3) acting as a single point of contact for State Industrial Extension Services; and

(4) making members of its staff available to the States to provide technical advice.

SEC. 6. PILOT GRANT PROGRAM.

(a) ESTABLISHMENT OF PROGRAM.—There is hereby established in the Department of Commerce a 3-year Industrial Extension Service Grant Program (in this section referred to as the "Program"), designed to provide a demonstration of methods by which the Federal Government can best help States establish, support, improve, and expand State Industrial Extension Services.

(b) SELECTION OF PARTICIPATING STATES.—(1) Any State desiring to participate in the Program shall submit an application therefor to the Secretary, in such manner and form as the Secretary may specify, describing in detail the particular activities it proposes to conduct in the course of such participation, the manner in which it proposes to conduct such activities, and the nature and extent of its need for assistance to support such activities.

(2) From among the States submitting applications under paragraph (1), the Secretary shall select and approve

not more than 15 States (or regional consortia of States) to participate in the Program. In making such selections the Secretary—

(A) shall give preference to those States whose participation in the Program appears most likely to promote the objectives of this section and the purpose of this Act, and whose applications indicate the greatest need for assistance to support the activities involved; and

(B) shall assure that to the maximum extent possible (in order most effectively to achieve such objectives and carry out such purpose) the grants made under the Program are distributed to all regions of the country and to States with differing forms of Extension Services and differing types of businesses.

(c) GRANTS.—(1) From the funds appropriated therefor, the Secretary shall make annual grants for the fiscal years 1988, 1989, and 1990 to each of the States (or consortia) selected and approved under subsection (b) to participate in the Program.

(2) Grants under the Program shall be made in such amounts and on such terms and conditions, consistent with the objectives of this section and the purpose of this Act, as the Secretary prescribes; except that in any event—

(A) the proceeds of each such grant must be used to increase the number of businesses served by the State's Industrial Extension Service or the amount and quality of the services provided, and no part of such proceeds may be used to pay for administrative expenses; and

(B) each State receiving such a grant must provide satisfactory assurances that it will contribute to the cost of the activities to be conducted and the services to be provided with the proceeds of the grant, from State or local funds, an amount equal at least to 20 percent of such cost, and that such contribution will be in addition to (and will not supplant or replace) any other expenditures which would otherwise be made from State and local funds for the same general purposes.

(3) Any State may provide services under the Program either directly, through the State Industrial Extension Service or through other State agencies and State personnel, or may arrange for the provision of any or all of such services by institutions of higher education or other nonprofit institutions or organizations under contracts or other appropriate arrangements entered into with them. In either case reasonable fees for services may be charged the businesses being served, and such fees may (subject to the terms of any con-

tracts or arrangements so entered into) be retained by the State.

(d) REPORTS.—(1) Each State receiving grants under this section shall submit annual reports to the Secretary on the conduct of its activities under the Program, including information with respect to the number and types of businesses served, the impact of such activities on jobs and economic conditions, and such other matters as may serve to indicate the extent to which the Program is promoting the objectives of this section and the purpose of this Act within that State (along with any suggestions it may have for more effectively promoting such objectives and purpose). The final report of each State shall be accompanied by an objective evaluation of that State's activities under the Program, prepared by a qualified independent public or private nonprofit organization or agency under a contract or arrangement entered into by that State.

(2) At the close of the fiscal year 1990, the Secretary shall submit to the Congress a full and complete report on the operation of the Program. Such report shall explain in detail the respects in which the Program has been successful in achieving the objectives of this section and the purpose of this Act and the respects in which it has not, shall be accompanied by the evaluations submitted by the participating States under the last sentence of paragraph (1) together with

the Secretary's comments thereon, and shall set forth the Secretary's recommendations for further legislative, administrative, and other actions to achieve such objectives and purpose.

(e) ROLE OF THE OFFICE OF EXTENSION SERVICES.—In carrying out his functions under this section, the Secretary shall consult with and appropriately utilize the personnel, facilities, and expertise of the Office of Extension Services in the National Bureau of Standards.

SEC. 7. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated for each of the three fiscal years 1988, 1989, and 1990, to carry out this Act—

(1) the sum of $1,000,000 for the Office of Extension Services established in the National Bureau of Standards under section 5;

(2) the sum of $250,000 for administrative expenses incurred by the Secretary in carrying out the Program under section 6; and

(3) the sum of $15,000,000 for grants to States under such Program.

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100TH CONGRESS
1ST SESSION

H. R. 2219

To amend the Stevenson-Wydler Technology Innovation Act of 1980 to establish a Center on State and Local Initiatives on Productivity, Technology, and Innovation, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

APRIL 29, 1987

Miss SCHNEIDER (for herself and Mr. WALGREN) introduced the following bill; which was referred to the Committee on Science, Space, and Technology

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A BILL

To amend the Stevenson-Wydler Technology Innovation Act of 1980 to establish a Center on State and Local Initiatives on Productivity, Technology, and Innovation, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Competitiveness Enhancement Act of 1987".

SEC. 2. ESTABLISHMENT OF CENTER.

(a) ESTABLISHMENT.—The Stevenson-Wydler Technology Innovation Act of 1980 is amended by inserting after section 5 the following new section:

"SEC. 5A. CENTER ON STATE AND LOCAL INITIATIVES ON PRODUCTIVITY, TECHNOLOGY, AND INNOVATION.

"(a) ESTABLISHMENT.—There is established in the Office of Productivity, Technology, and Innovation a Center on State and Local Initiatives on Productivity, Technology, and Innovation. The Center shall be headed by a Director for State and Local Initiatives on Productivity, Technology, and Innovation, who shall be appointed by the Secretary. The Director shall report to the Secretary through the Assistant Secretary.

"(b) CLEARINGHOUSE.—The Center shall serve as a clearinghouse of information on initiatives by State and local governments to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation. To carry out the preceding sentence, the Director shall—

"(1) establish relationships with State and local governments, and regional and multistate organizations of such governments, which are carrying out such initiatives;

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"(2) collect information on the nature, extent, and impact of such initiatives, particularly information useful to State and local governments and small businesses;

"(3) disseminate information collected under paragraph (2) to Congress, Federal agencies, State and local government agencies, and the public;

"(4) publish handbooks and materials concerning methods which may be used by State and local governments to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation; and

"(5) hold public and private conferences and seminars.

"(c) Evaluation of State and Local Initiatives.—(1) The Director shall—

"(A) evaluate the effectiveness of initiatives by State and local governments to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation;

"(B) develop methodologies for the conduct of the evaluations described in subparagraph (A); and

"(C) disseminate information concerning the effectiveness of any initiative evaluated under subparagraph (A) and any methodology developed under subparagraph (B) to Federal agencies, the Congress, State and local governments, and the public.

"(2) The Director may only conduct an evaluation of a State or local initiative under paragraph (1)(A) and disseminate information regarding the effectiveness of any initiative under paragraph (1)(C) if the State or local government carrying out such initiative consents to and cooperates with such evaluation.

"(3) In carrying out subparagraphs (A) and (B) of paragraph (1), the Director may enter into contracts with State and local governments and public and nonprofit entities. Any such contract may provide that a portion of the costs of carrying out such contract will be paid by another Federal agency, a State or local government, or a public or nonprofit private entity, which is a party to such contract.

"(4)(A) The Director shall by regulation require any public or nonprofit private entity which proposes to enter into a contract under paragraph (3), whether by advertising or negotiation, and which under such contract will pay a portion of the costs of carrying out such contract, to provide the Director, prior to entering into any such contract, with all relevant information bearing on whether that entity has a possible conflict of interest with respect to (i) being able to render impartial, technically sound, or objective assistance or advice in light of other interests or relationships with other persons or entities, or (ii) being given an unfair competitive advantage. Such entity shall insure, in accordance with regulations published by the Director, compliance with this paragraph by subcontractors of such entity who are engaged to perform similar services.

"(B) The Director shall not enter into any contract under paragraph (3) unless the Director affirmatively finds after evaluating all such information and any other relevant information otherwise available to the Director, either that (i) there is little or no likelihood that a conflict of interest would exist, or (ii) that such conflict has been avoided after appropriate conditions have been included in such contract. Notwithstanding the preceding sentence, if the Director determines that such conflict of interest exists and that such conflict of interest cannot be avoided by including appropriate conditions in such contract, the Director may enter into such contract if the Director determines that it is in the best interests of the United States to do so and includes appropriate conditions in such contract to mitigate such conflict.

"(C) The Director shall publish rules for the implementation of this paragraph in accordance with section 553 of title 5, United States Code, as soon as possible after the date of enactment of this section but in no event later than 180 days after such date.

"(d) IMPROVEMENTS IN FEDERAL PROGRAMS.—The Director shall—

"(1) study ways in which Federal agencies can use existing policies and programs to assist State and local governments in carrying out initiatives to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation;

"(2) make periodic recommendations to the Secretary through the Assistant Secretary, concerning modifications in such policies and programs which would improve such assistance; and

"(3) convene meetings and conferences of Federal, State, and local officials in order to carry out joint and cooperative initiatives to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation.

"(e) ADVICE AND TECHNICAL ASSISTANCE.—On request of a State or local government, the Director shall—

"(1) advise such government with respect to initiatives undertaken by such government to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation;

"(2) provide technical assistance to such government with respect to such initiatives; and

"(3) assist such government in determining sources of assistance from other Federal agencies which may be available to support such initiatives.

"(f) GENERIC RESEARCH.—The Director shall—

"(1) conduct, or support the conduct of, generic research on—

"(A) the process of stimulating productivity, technology, and innovation; and

"(B) methodologies for the evaluation of initiatives by State and local governments to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation; and

"(2) make the results of such research available to Federal agencies, the Congress, State and local governments, and the public.

"(g) ANNUAL REPORT.—The Director shall prepare and transmit to the Congress an annual report on initiatives by State and local governments to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation. Each report required by this section shall contain—

"(1) a description of such initiatives;

"(2) summaries of evaluations conducted by the Director under subsection (c);

"(3) a description of any research supported by the Director under subsection (f) and of the findings and conclusions of such research; and

"(4) recommendations for activities by Federal agencies to support State and local initiatives to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation.

"(h) FOCUS OF ACTIVITIES.—In carrying out the preceding subsections, the Director shall ensure that activities of the Center focus on—

"(1) State and local initiatives to stimulate the formation of new small businesses, to increase the competitiveness of industries, and to create a favorable climate for entrepreneurs;

"(2) State and local initiatives involving cooperation among government agencies, regional organizations, businesses, labor organizations, and nonprofit institutions;

"(3) State and local initiatives to—

"(A) gather and disseminate information;

"(B) promote research and development;

"(C) foster cooperation between labor and management;

"(D) generate venture capital;

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"(E) assist in the development of human resources through technology and innovation;

"(F) organize partnerships among businesses and educational institutions;

"(G) expedite the transfer of technology;

"(H) provide training in entrepreneurship;

"(I) improve management and technical effectiveness of technology; and

"(J) assist in making technology available for commercial use; and

"(4) State and local initiatives to encourage the establishment of flexible, computer-integrated manufacturing systems.

"(i) LIMITATIONS.—(1) The Director shall not—

"(A) provide financial assistance to a State or local government to support the implementation of any initiative to enhance the competitiveness of American businesses through the stimulation of productivity, technology, and innovation, other than any financial assistance which is necessary for the conduct of an evaluation of such an initiative under subsection (c);

"(B) provide financial assistance to support State and local government initiatives to stimulate economic development through the conduct of public works or the repair or replacement of infrastructure;

"(C) provide any assistance to a State or local government in efforts to encourage a private business to locate any facility in a State or local jurisdiction or to relocate any facility from one State or local jurisdiction to another; and

"(D) consider any issue included in a specific labor-management agreement without the consent and cooperation of all parties to the agreement.

"(2) The Director may conduct, or provide for the conduct of, research with respect to matters described in subparagraphs (B) and (C) of paragraph (1).

"(j) REGIONAL OFFICES.—In fiscal year 1989 and each of the succeeding fiscal years, to carry out this section, the Director shall assign professional personnel of the Center to regional officers of the Department of Commerce.

"(k) ADMINISTRATION.—(1) The Secretary shall carry out paragraphs (7) and (8) of section 5(c) through the Director.

"(2) In carrying out this section, the Director—

"(A) shall work closely with other Federal agencies, including the Department of Agriculture, the Department of Defense, the Department of Labor, the National Science Foundation, and the Small Business Administration;

"(B) may, jointly with other Federal agencies, enter into contracts with public and nonprofit private entities; and

"(C) shall work closely with Federal, State, and local agencies responsible for enhancing export opportunities for United States businesses.

"(l) ADVISORY BOARD.—The Director shall establish an advisory board to advise the Assistant Secretary and the Director on the policies, priorities, and activities of the Center. The advisory board shall include a broad range of members, including officers of State and local governments, leaders in business and labor, and experts on productivity, technology, and innovation. The advisory board may make recommendations to the Assistant Secretary, the Director, and the Congress concerning ways in which Federal agencies can use existing policies and programs to assist State and local governments in carrying out initiatives to enhance the competitiveness of American business through the stimulation of productivity, technology, and innovation.

"(m) AUTHORIZATION OF APPROPRIATIONS.—To carry out this section, there are authorized to be appropriated $500,000 for fiscal year 1988, $1,000,000 for fiscal year 1989, and $1,500,000 for fiscal year 1990 and each of the succeeding fiscal years. Amounts appropriated under this subsection shall remain available until expended.".

(b) Definitions.—Section 4 of such Act is amended by adding at the end thereof the following new paragraphs:

"(13) 'Center' means the Center on State and Local Initiatives on Productivity, Technology, and Innovation established by section 5A.

"(14) 'Director' means the Director for State and Local Initiatives on Productivity, Technology, and Innovation appointed under section 5A(a).".

"(c) Reporting by Assistant Secretary.—Section 5(b) of such Act is amended by adding at the end thereof the following new sentence: "The Assistant Secretary shall report directly to the Secretary.".

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Mr. **Price**. Thank you. We will forego any questions until we have heard from all the Panel Members. Dr. Rhodes.

Dr. **Rhodes**. Mr. Chairman, I am grateful for the opportunity to speak to you and I want to congratulate you and Members of your Committee for sponsoring these hearings.

We believe that the universities, and especially the research universities have a vital contribution to make, not only in training the next generation of engineers and scientists, but also in the transfer of technology from their own research and extension efforts.

My own institution, Cornell University, for example, ranks third in the Nation in research expenditures. We spend about $225 million a year in research funding. That comes from the Federal Government, it comes from the State, but it also comes from foundations, and increasingly from industry.

In fact, engineers and scientists from many of the leading corporations work side by side on the campus, at the same benches as our own people. These include such well-known corporations as IBM, Corning Glass, General Electric, McDonnell Douglas and AT&T.

This pattern is part of a virtual explosion that has taken place in recent years in alliances between the universities and industry. Increasingly, as the land grant university, our faculty are called upon not simply to provide agriculture advice and assistance throughout the State, but also to play a wider role in supporting the development and growth of new and existing industries.

And that not only for the General Electric and the IBMs of the world, but also for the small businesses and the small entrepreneurial firms from whom, if they get the assistance they need, is going to come the next generation of industrial leaders.

125 years ago this year, in 1862, Congress authorized the Morrill Act, and that Act developed a proposal to create an organized network of universities throughout the Nation, the land-grant university system. That was at a time of similar economic distress for the Nation.

It enabled the land-grant universities to foster not only agriculture, and extend the benefits of their knowledge throughout each of the States, but also to teach the mechanic arts, or what we should now call engineering. And, although the land-grant universities have provided instruction in engineering, they have not had the means to develop a research program in engineering that could be disseminated to the people of the States they serve.

I am proposing today that we need a new kind of extension program, one that I would call an industrial extension program, not modeled exactly upon the old land-grant agricultural extension program, but something equivalent to it with individual scientists and engineers serving in a new role to advise corporations, both large and small.

That would involve not simply walking the country lanes and advising farmers, but a sophisticated network of computers and data banks, helping to cope with the enormous technical diversity and needs represented by American industry.

I should say that we already have the forerunner for that kind of industrial network in existence. Cornell, for example, is a principal node in a number of high-speed fiber optic and satellite networks that already link the National Supercomputing Center at Cornell, directed by Nobel Laureate Ken Wilson, with other universities, with Government labs, and with major industries throughout the State and around the Nation.

So a model exists which could serve as a basis for this. The model I propose of an industrial extension network is also consistent with other models that already exist.

We have, for example, such models as those at the National Science Foundation, creating university-based supercomputer centers. In the State of New York, we have a State-funded program, supporting centers for advanced technology.

The one at Cornell devoted to biotechnology has for its industrial partners General Foods, Kodak and Union Carbide, and that model could be expanded on a much greater basis.

So I am seeking to suggest that models exist which should encourage us to consider the development of legislation to establish an industrial extension program, nationwide, that would urge the states to set up at the State level, statewide efforts to provide clearing houses and support for scientific and technical information.

That would be improved, I think, if the States developed those centers on existing land-grant campuses. That would shorten the lead time between research and development. Models already exist for the Sea Grant program and a Water Resources Research legislation.

I hope that if you do choose to fund this, that initial funding will at least be sufficient to enable us to judge the value of the experiment. I recognize, of course, that any request for funding from the Federal Government faces severe constraints at a time like this, but I also believe, Mr. Chairman, that you and the Congress are correct, and the current emphasis that you now place on economic competitiveness as being amongst the most urgent national problems that we face.

Unless we address and solve that problem, everything else that we cherish is likely to suffer.

Let me give two or three brief examples of ways in which Cornell has jumped the gun on this and has not waited for a Federally financed program, but has sought to reach out on a small scale to provide models of industrial extension.

With a small grant from the State of New York, we have set up two working engineers who roam the counties, an eight-county area adjacent to the university, to help in consulting concerning industrial needs.

They have already served 32 different companies, but out of the 900 companies in that eight-state area, about 350 others also require additional help. Let me cite one specific example.

A small subsidiary of Rubbermaid Corporation in the City of Courtland, New York, has state-of-the-art injection molding machines but had not been able to use them efficiently. They sought the help of our program in reducing the cycle times without impairing the quality of the product. That now forms the basis of studies by faculty members and students in support of that.

Another program supported by our School of Industrial and Labor Relations, known as PEWS, seeks to integrate management and labor together in avoiding plant closings and loss of jobs by concentrating on training and product development, and increased involvement of the work force in problem solving and cost-cutting.

One simple example will show how effective that can be. In Buffalo, a plant of Trico Products, a major manufacturer of windshield wipers reached a decision that it would close its Buffalo plant with a loss of 2,000 jobs and move its operations to the Mexico-Texas border.

PEWS was invited in to discuss with management and labor ways in which productivity could be increased. For the sum of $125,000 contributed jointly by the State, Trico and Cornell, they set up management and employee teams that effectively saved 894 jobs when Trico reversed its decision to move all its operations to the Southwest.

Some were moved; almost half of the workers, however, continue to be employed. It is not just small companies, but larger ones, such as Xerox, which have shared the benefits of that particular program.

A comparable program at Xerox has led to the savings of $3.7 million a year, more than 15 percent above the target level established by Xerox in moving towards that particular consultation.

So we have already modest examples on a limited scale of well-trained specialists in management and engineering, seeking to solve the problems of small businesses and new industries in one particular State.

Other efforts range from a catalogue of data base for industry and labor force and building sites, to a much wider statewide data base involving research and marketing.

I mention these because they are consistent with an initiative that one university has taken which could be duplicated by many others across the Nation. They provide a sampling only of what could be done if a new program were developed that would encourage states to institute similar programs.

For well over 75 years, the extension based on the agricultural program of our land-grant universities have brought extraordinary gains in agricultural productivity and in the marketability of our agricultural products, not only at home, but also abroad. That has contributed to a dramatic improvement in the standard of living in our rural communities.

If Congress were to choose to encourage and establish the development of an industrial extension system in the States, I believe we could have similar achievements in productivity in our manufacturing industries. We could increase sales in overseas markets, and we could contribute to a stronger national economy and a better life for all.

We should aspire to no less than that.

Mr. Chairman, I am grateful for the opportunity to speak before you and I should be happy to respond to questions.

[The prepared statement of Dr. Frank Rhodes follows:]

STATEMENT BY FRANK H. T. RHODES,
PRESIDENT, CORNELL UNIVERSITY
BEFORE THE SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
HOUSE COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
April 30, 1987

Mr Chairman, members of the Committee:

I congratulate your committee for sponsoring these hearings on how to capitalize on the strengths of America's basic research enterprise to improve our industrial competitiveness in the world marketplace. America's greatest strength has been, is, and always will be the creativity of its people. Our research universities--by advancing knowledge in science, technology and many other fields--provide the wellspring from which high technology flows, and on which our economic competitiveness and social well being increasingly depend.

My own institution, Cornell University, for example, presently ranks third in the country in research expenditures, spending about $225 million per year on research, with funding from federal, state, corporate, foundation and institutional sources. Included in this activity are programs involving scientists and engineers from the University, from government and from industry in such crucial fields as microelectronics, biotechnology and supercomputing. Recent articles in Forbes and Fortune magazines, for instance, have featured the cooperative research programs at Cornell which are strengthening the manufacturing position of such firms as IBM, Corning Glass, General Electric, McDonnell Douglas and AT&T. Scientists and engineers from these corporations work at Cornell with our researchers on both basic and applied research problems. This pattern of university-industry interaction is part of what a recent National Academy of Sciences report characterized as a "virtual explosion over the past several years in the number and variety of university-industry alliances."

Increasingly, our faculty are involved in improving mechanisms for the transfer to the industrial sector of the results of university research. Moreover, Cornell's role as the land-grant university for the State of New York confers on our university a special obligation for public service. Fulfillment of that role has been manifest for more than 75 years in agriculture through effective programs of the nation's Cooperative Extension program. Cornell has no less an obligation to promote the economic well-being of our state and nation through outreach and assistance to the business and industrial community--not only to the IBMs and General Electrics of the world, but to the small businesses and entrepreneurial firms, from amongst whom--if they can benefit from access to expertise available from our research universities--will come the new industrial leaders of tomorrow.

A few years ago I developed a proposal to create an organized network linking universities and industries that would take as its model the Morrill Act of 1862. It was the Morrill Act which created the land-grant university system in this country at a time of considerable national economic dislocation. The Morrill Act called upon the land-grant institutions to foster not only agriculture but the teaching of the "mechanic arts"--what we now call engineering.

Although land-grant universities have provided instruction in engineering for more than a century, they have not received the additional funding for research and extension--for discovery and dissemination--that has been crucial to success in agricultural extension. I do not suggest that an industrial extension system needs to replicate the traditional network of agricultural extension agents. However, we do need something equivalent to a network of extension agents to link the specialized skills of individual scientists and engineers in our research universities to the particular technological and management needs of individual companies--large or small. The extension agents for an industrial extension system would have to be highly sophisticated and technically literate.

The system I envision also would involve extensive use of computer networks from data banks to help cope with the enormous technical diversity and complexity presented by American industry. The forerunners of such networks already are in place involving major research universities such as Cornell. Cornell is a principal node in a number of high speed, fiber optic and satellite networks that link the national supercomputing program at Cornell, directed by Nobel Laureate Ken Wilson, to research universities, federal laboratories, and leading corporations in New York State and around the nation. So a model exists.

The kind of industrial extension system I envision can help America run faster than our foreign competitors through innovation and productivity, providing our industrial society with far better "protection" than can import quotas, tariffs and other protectionist measures.

The initiative I propose is entirely consistent with national and state policy which encourages university-industry cooperation in a wide variety of ways. I have already mentioned the Morrill Act and its charge to the land-grant universities to foster agriculture and the mechanic arts in every state. Today we have such examples as the university-based supercomputer centers, sponsored by the National Science Foundation with the stipulation that industry be a major partner in both the support and use of these national resource facilities. In New York State we have a program to support Centers for Advanced Technology at universities, also strongly oriented toward industrial participation and economic development. The Center at Cornell is devoted to biotechnology in agriculture and has brought us into partnership with Kodak, General Foods and Union Carbide.

Legislation to establish a national industrial extension system could offer a helping hand to the individual states in setting up administrative mechanisms to coordinate state-wide efforts and provide a central clearing house for scientific and technical information. It could charge the states with an obligation to channel funds to universities to undertake industrial extension programs.

I believe the chance for successful implementation of a national industrial extension system would be considerably improved if the states were directed to establish the central administrative structure on a university campus in each state. This would shorten and strengthen the linkage between academia and industry and would lessen the chance that all funding would come to rest in the administrative structures in the state capitols. There are already good models for doing this in the Water Resources Research legislation and the Sea Grant program.

I am also concerned that the proposed initial funding be sufficient to carry the program far enough to demonstrate the kinds of results which will allow us, in the years ahead, to determine the effectiveness of the program. I recognize, of course, that the current fiscal situation is such that any new initiative is very hard to launch at all, let alone fund at the levels needed to ensure success. I believe, however, that the Congress is correct in its current emphasis on economic competitiveness as our most urgent national problem. We can solve that problem only with bold steps. And unless we solve it, everything else that we cherish is threatened.

Because we believe so strongly in the industrial extension concept, Cornell has not waited for the establishment of a federally financed national program. Let me describe some of these efforts, because specific examples help us all to understand what the concept of industrial extension means in practice. These activities are generally being undertaken on a small scale, in some cases with assistance from the State of New York.

With a grant of $146,000 from the New York State Science and Technology Foundation and equivalent support from the university, our College of Engineering, in conjunction with the Cornell Cooperative Extension system, established this year an Industrial Innovation Extension Service, to help small- to medium-sized companies in the eight-county area surrounding the university to improve their productivity and profitability.

Graduate engineers Berdell Boss and Herschel Blackburn, each with solid industrial experience, work in the field as industrial extension specialists. They identify companies that can benefit from new technology, and develop ways to get the needed help. In some cases the specialists provide direct assistance based on their own experience, as in the performance of an operations audit. In other cases, the problems have become subjects for student projects and research programs. Companies have received help in production scheduling and inventory, plant layout, integration of a CAD (Computer Assisted Design) system and the application of manufacturing resources planning concepts.

So far, the specialists have been working with 32 firms. There are 907 industrial firms in the eight-county area, and at least 362 of them have been identified as potential clients. I want to emphasize that one of the chief benefits of this program, from the university's point of view, is the practical hands-on educational experience provided to students.

Let me cite a specific example. A Rubbermaid subsidiary in the city of Cortland, New York has state-of-the-art injection molding machines, but sought the help of our College of Engineering for using them more effectively. The goal of the project is to reduce cycle times without impairing product quality. The first step is to simulate and optimize mold-filling dynamics for deep cup molds. In the second phase, the results of the research will be implemented in the plant. Candidates for the degree of Master of Engineering gain hands on experience by assisting in this project under the guidance of Professor K. K. Wang.

In another example, the Saulsbury Fire Apparatus Company in Tully, New York has experienced production scheduling and inventory problems as it has grown. Saulsbury is funding three of our Engineering students under the direction of Professor Lee Schruben to study the application of manufacturing resources planning concepts to their situation.

Another effort, based in the School of Industrial and Labor Relations at Cornell, is called Programs for Employment and Workplace

Systems (PEWS). PEWS has developed an integrated approach to avoid plant closings and loss of jobs in New York State. Strategies to avoid these closings range from training, product development, and modernization, to increased involvement of the workforce in problem-solving, cost cutting and improving productivity.

One well publicized example of PEWS activity involves the Buffalo plant of Trico Products, Inc., a major manufacturer of windshield wipers. The company planned to move its operations to the Mexico-Texas border with a potential loss of 2,000 jobs to Buffalo's already depressed economy.

PEWS co-director Peter Lazes used $125,000 contributed by New York State and Trico to employ architects, business analysts and industrial productivity experts to work with Cornell faculty, staff and students to identify ways to improve the efficiency and effectiveness of Trico's Buffalo operations. These experts spent months inside the Trico plant, and perhaps most important of all, were successful in setting up management and employee teams to seek cost-saving efficiencies. A few months ago, Trico announced that although it was moving a substantial part of its operations to the Rio Grande, the efforts to identify ways to reduce costs in the Buffalo operations led them to decide to keep a number of Trico operations in Buffalo, saving 894 jobs in the Buffalo area.

Mr. Lazes and his colleagues also played an important role in a cost-cutting union-management collaboration by Xerox Company in Rochester, which enhanced that company's competitiveness without having to resort to cutbacks in Xerox's labor force. The PEWS team worked with both union and management to help develop and train shop-floor problem-solving teams, and to identify the necessary organizational and policy changes to support and sustain these activities. The anticipated savings from this effort amount to $3.7 million per year, more than 15 percent above the target set by the company when the experimental project was started. PEWS has also undertaken an extensive study of employee involvement and work redesign in 32 shipyards, and is seeking funds from the U.S. Maritime Administration to continue these activities.

Here again, the success of these programs depends on well-trained specialists who understand the problems in the field, extensive involvement of Cornell faculty in a wide variety of fields, and students who are provided with an unparalled opportunity to learn skills that can be applied to the real problems they will face when they enter the workplace.

Professor Alan McAdams, of Cornell's Johnson Graduate School of Management, has worked with graduate students to develop a comprehensive database on industry, the labor force, buildings and sites, demography and other characteristics germane to economic development in a three-county area of upstate New York. The results of this study are being used by local industry and by planning agencies. I should point out that Cornell also has a powerful economic development tool in the Cornell Institute for Social and Economic Research (CISER), which has developed statewide data bases of many sorts and specializes among other things in survey research and marketing.

The recent expansion of extension activities in Cornell's College of Engineering, School of Industrial and Labor Relations, and the Johnson Graduate School of Management are characteristic of our effort to broaden the focus of the University's extension programs to serve a new category of clients that need access to university-based knowledge if they are to remain competitive.

Last year I appointed a Commission of distinguished leaders from New York and across the nation to reassess the historic mission of the Cornell Cooperative Extension System in the light of socio-economic changes and to propose priority program areas for the future, taking into account the needs and demographics of New York State and the university research and knowledge base capability. The commission was chaired by Robben W. Fleming, President Emeritus of the University of Michigan and former President of the Corporation for Public Broadcasting.

I would like to quote a key paragraph from the Commission's report.

> "Applying research-based knowledge and encouraging networking are means by which Cornell and county associations can contribute to economic development throughout the state. Important program opportunities are those that enhance small business, increase recognition of the importance of the community infrastructure including transportation, utilities and other local services, stimulate recreation and tourism, protect water quality and improve waste handling, improve energy efficiency of small businesses, transfer biotechnology, and promote industrial innovation. Working relationships can be established and expanded between business firms and college researchers which will increase business investments and private sector jobs. One very attractive aspect of this set of problems is that it requires interdisciplinary talent from several different colleges and also provides a close tie between basic and applied research."

Mr. Chairman, my remarks provide only a sampling of what Cornell does to enhance America's productive capacity. I have not dealt with similar and related activities which are underway at other universities. Nor have I described in detail the close collaboration where industrial researchers actually work side by side with our faculty members in the laboratory. This, of course, is the situation in which technology transfer can be most effective.

I do hope, however, that I have illustrated how Cornell and our sister institutions can play an even more important role than they do now in undergirding our nation's industrial strength and world competitive position.

Thank you. I will be glad to respond to any questions you may have.

December, 1986

FRANK H. T. RHODES

Frank H. T. Rhodes is the ninth president of Cornell University. He was elected on February 16, 1977, took office on August 1, and was inaugurated in formal ceremonies on November 10, 1977, all in the University's 113th year. (Cornell was founded in 1865.)

A geologist by training, he holds the faculty rank of professor of geology at Cornell.

Before assuming the Cornell presidency, Rhodes was vice president for academic affairs at the University of Michigan for three years. He joined the Michigan faculty as professor of geology in 1968, and, in 1971, was named dean of the College of Literature, Science and the Arts, the largest of Michigan's 18 schools and colleges.

Rhodes was born October 29, 1926, in Warwickshire, England. He received a bachelor of science degree with first-class honors in 1948 from the University of Birmingham, England, followed by a doctor of philosophy degree and a doctor of science degree from the same institution. He holds 13 honorary degrees, including the degree of LL.D. from the College of Wooster and Nazareth College of Rochester, L.H.D. from Colgate University, The Johns Hopkins University, Wagner College, Hope College, Rensselaer Polytechnic Institute, LeMoyne College, and Pace University, D.Sc. from the University of Wales, Bucknell University, and the University of Illinois, and D.Litt. from the University of Nevada at Las Vegas. He is an honorary member of Phi Beta Kappa.

He went to the University of Illinois in 1950 as a postdoctoral fellow and Fulbright scholar. From 1951 through 1954 he was a lecturer in geology at the University of Durham, England.

He returned to the University of Illinois as an assistant professor in 1954, was named associate professor in 1955, and became director of the University of Illinois Field Station in Sheridan, Wyoming in 1956.

Rhodes then went to the University of Wales, Swansea, in 1956 as professor of geology and head of the geology department. In 1967 he was named dean of the faculty of science there.

He has received numerous awards, including the Daniel Pidgeon Fund, Lyell Fund and Bigsby Medal, all from the Geological Society. He was the Gurley Lecturer at Cornell in 1960 and director of the National Science Foundation-American Geological Institute First International Field Studies Conference in 1961.

Rhodes was National Science Foundation senior visiting research fellow at Ohio State University in 1965-66 and Bownocker Lecturer there in 1966.

Since 1962 he has been editor of the geology series of the International Library of Science and Technology.

Rhodes is a member of the Geological Society of America, American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, the Paleontological Society, the Palaeontological Association and the Palaeontographical Society. He was chairman of the International Conodont Symposium in 1970. He is a Fellow and has served as a council member of the Geological Society of London. He has also served as vice president of the Palaeontological Association, and Section C of the British Association for the Advancement of Science.

He served as external examiner in geology to the Universities of Bristol, Belfast, Oxford and Reading and, for advanced degrees, to various other universities in Australia, India, the United Kingdom and Canada. He was an official visitor, traveling as a representative of the British Council, to universities in Australia, Pakistan, India, Turkey, Iran and Malaysia. He was also an Australian Vice-Chancellors' Committee Visitor to Australian universities. He was a Visiting Fellow at Clare Hall, Cambridge, in 1982.

Rhodes has served as chairman of the curriculum panel of the Council on Education in the Geological Sciences. He has also occupied various positions in British governmental bodies including membership on geology and geophysics subcommittees of the Natural Environment Research Council (NERC), and the Board of the Geological Survey. As a member of the NERC's Earth Sciences Committee, he was involved in the over-all direction and long-range planning of government research and development in the United Kingdom in geological survey, natural resources, conservation and overseas aid programs.

Rhodes has served as a member of the Michigan State Board for the Humanities, university accreditation review panels for the North Central Association of Colleges and Schools, and as Director of the Southeastern Michigan Science Fair.

He is a former member of the Smithsonian Institution's advisory research committee. He is presently Chair of the Board of Directors of the American Council on Education, and a member of the boards of trustees of the Gannett Foundation and the Committee for Economic Development, a member of the Board of Overseers of the Memorial Sloan-Kettering Cancer Center, a member of the boards of directors of the Tompkins County Trust Company, the General Electric Company and the Andrew W. Mellon

Foundation. He is also Chairman of the Advisory Board of the Gannett Center for Media Studies, a member of the Business-Higher Education Forum, a member of the Council on Foreign Relations, Incorporated and a Council Member of the International Executive Service Corps.

He is the author of over 70 major scientific articles and monographs, some 40 articles on education, and five books. Among his publications are Evolution, Fossils: A Guide to Pre-Historic Life, Geology, The Evolution of Life, and Language of the Earth. He was the senior author of the monograph on undergraduate education published by the American Geological Institute.

Rhodes has been author, consultant and participant in several educational radio and television programs, including the British Broadcasting Corporation (BBC) television series "The Planet Earth" and the BBC radio series "Science, Philosophy and Religion."

Rhodes, a naturalized United States citizen, and his wife, the former Rosa Carlson, of Iron Mountain, Michigan, have four daughters. They live at 603 Cayuga Heights Road, Ithaca.

Mr. PRICE. Thank you, very much, Dr. Rhodes. We will now hear from Joe Kazmarek, of Impact Technology, Inc., Bethlehem, Pennsylvania.

Mr. KAZMAREK. Thank you, very much, Mr. Chairman, for the opportunity to address this Committee and to share my perspective as a small company who participates in a state-funded technology transfer program.

Impact Technologies is a two-year old software development company who participates in a state-funded technology transfer program.

Impact Technologies is a two-year old software development company who was started as a result from a grant from the Ben Franklin Partnership Fund. Ben Franklin Partnership is Pennsylvania's version of a technology transfer program, and has been in existence for five years. It was originally started as a $1 million concept. It has now expanded to a $30 million per year program with over $100 million a year in matching contributions coming from the private sector funds.

As Dr. Rhodes has pointed out in support of New York's programs and Cornell University's participation, Pennsylvania has a similar program. We work with Lehigh University and are housed on Lehigh University's campus. We work very closely with the university in developing programs to help local and state private sector industry improve the productivity of their operations.

At this point, I would like to comment on some of the key problems that we see in implementing the state programs and as a preliminary to commenting on the two bills in question, I think some of the key problem areas that exist are that there is a visibility problem of state and federal programs.

There is no single source to which to turn to find which state and federal programs are applicable to a given business scenario. I also feel that there is a necessity, if a federal program were to be set up for a performance dimension that needs to be added to this program.

I also feel that there should be a requirement for some private sector participation in the federal process because we bring a dimension to the decision-making process that would not otherwise be possible.

A couple of key problems that Pennsylvania has had in implementation of its program is that there is a lack of regionalization effort, and there is a tremendous amount of duplication of technologies, and duplications of efforts with respect to determining which administrative policies would be most effective in implementing the state technology transfer programs.

We also believe that the Federal Government should provide some guidance for an overall economic strategy to improve global competitiveness of American industries. We feel that the Federal Government is in the best position to provide this initiative to state technology transfer programs, and to private industry.

Finally, I believe that in addition to technology transfer, there needs to be a technology awareness dimension to a federal program that would be set up in order to foster business excellence, technology awareness and excellence in innovation and entrepreneurship.

First of all, I would like to discuss some of the problems confronting businesses that wish to use the available technology programs. We feel that the SPDC comes close to providing the service of visibility, but even it does not have complete visibility and understanding of all programs that are available.

We feel that a referral service of sorts for any business, regardless of its size would be extremely helpful in quickly identifying the full spectrum of programs which could help a business with a particular problem or range of issues.

Many of the existing state and federal programs which could help a business with a particular problem or range of issues.

Many of the existing state and federal programs lack performance measurement dimensions and the requirement of private sector participation in academic institution research. While these programs do increase the body of available technical knowledge, without input of the parties who could ultimately use these technologies, many of the practical implications and limitations of such research are often ignored.

Many programs do not strictly enforce performance criteria, such as private sector matching fund measurement and economic impact measurement.

Without a strict insistence upon this requirement it will be difficult to measure the success or failure of various projects, specific private industries and academic institutions. Federal funding for technology transfer programs therefore should insist on private sector participation in the enforcement of project performance criteria.

Most state-funded technology transfer programs have focused on increasing and maintaining business activity within a state. This has put many state programs and businesses from different states in direct competition with each other. This is not necessarily bad since it fosters the continual improvement of state programs with respect to other states, and promotes the fundamental underlying philosophy of our capitalistic economy.

On the other hand, millions of dollars are being wasted on the duplication of technology development in the name of success of individual state programs. Additionally, there is a large collective body of knowledge which exists when one considers what each of the state programs has learned about the successes and failures of implementing their programs.

Many programs are not as successful as others simply because they are newer and do not have the benefit of experience that the older programs have. Also, there is a large variation in how each of the state programs operate. With a more detailed exposition of each state's experiences, more effective programs would result from the application of this collective knowledge.

Some of the state agencies have already recognized this opportunity and have taken steps to encourage cooperation between state agencies through the formation of regional consortiums.

In my written testimony, I point out several examples.

Technology transfer is an excellent concept and it is indeed working. Impact Technologies has gone from a one-employee company, with no outside capital investment, with strictly state grants, we have been able to grow to a company of 13 employees, with projected sales for 1987 of $1 million. By 1990, we feel Impact Technologies should have between 75 and 100 employees.

In order to overcome a problem as large as the economic difficulties we face today, I feel that state programs could use direction from the Federal Government to focus their efforts on technologies and industries which are most crucial in reestablishing our global competitive position.

Upon reviewing the two bills in question, I find that both have considerable merit in attempting to apply the technology which state programs are helping to develop.

I would like to focus on the proposed Federal Extension Service of 1987. My understanding of the bill is that it proposes to set up a federal agency under the National Bureau of Standards in cooperation with the National Technical Information Service.

This program would be responsible for supporting state-funded programs by providing direct advisory and financial assistance, acting as a central source for information about available programs at all levels, encouraging regional cooperation between existing programs, and making foreign technical literature and the services of the federal laboratory consortium more accessible.

Additionally, each federal agency which provides industrial extension services shall be responsible for communicating available services to the Federal IES director.

My initial reaction to the bill is that it is vague in its intent and implementation. I think that the overall objectives of the bill are essential to the improved success of state programs. However, the details as to how this bill would accomplish these objectives are not very clear.

Also, I question the method by which payment would be made to state programs in support of the IES. Should a state program which provides $35 million of funding receive the same federal dollar support as a state program which provides only $2 million in annual funding? Perhaps a base federal amount proportional to the amount of funding a state provides, plus a competitive request by the state for federal amounts above and beyond the base amount according to demonstrated need will provide more state service per federal dollar and encourage creative ways for states to enhance their participation in the program.

Also, might $500,000 be too little to start a federal program of this nature, since only $500,000 is scheduled to remain with the Federal Government?

The Senate Bill, S. 930, the Competitiveness Enhancement Act of 1987, is somewhat similar to the House bill, but I feel it is more comprehensive in nature. The objectives of the bill are very clear. The mechanisms by which the programs would function are more clearly defined.

My interpretation of the bill is that it seeks to establish a new federal agency under the existing Office of Productivity, Technology and Innovation, that will focus on the stimulation and enhancement of state and local programs, and the improved visibility of federal efforts to the state programs.

I feel that the Senate bill effectively addresses key areas. Like the House bill, it will establish a federal agency to act as a clearing house about programs at all levels. This is critical to the functioning of the state programs.

It provides for a third-party evaluation of the effectiveness of individual state and local programs, thereby promoting a critical evaluation and the sharing of such information between programs.

It also provides a mechanism by which the program would provide feedback for the improvement of existing federal programs. It also provides a single source for which agencies can turn to for determining applicable federal programs for a given scenario.

Section (f), generic research, I think is particularly interesting and impressive. While funding has been available for assistance on individual projects, I feel that monies allocated to studying the range of programs offered by various state and local agencies, their relative successes, and the entire issue of economic revitalization would yield a tremendous return on each dollar.

Benefits would also be derived at all government levels and would stimulate greater creativity within state programs.

Section (h) on focus of activities defines the range of responsibilities and opportunities of the Center. In my opinion, this is the most impressive access of the bill. In addition to addressing most of the concerns voiced in the preceding paragraphs, this section includes other topics in the scope of the Center on State and Local Initiatives.

These key enhancements are evaluation of programs to foster cooperation between labor and management; assistance in the development and retraining of human resources; training and entrepreneurship; and the improvement of the management of technology.

Also, the utilization of an advisory board composed not only of federal members, but also of state and local officers, as well as private sector business members and innovation leaders will provide a broad perspective in enhanced state programs and business participation in the federal program. The use of this advisory board to provide feedback to the legislative process that has created it, is also an important feature for successful implementation of these program enhancements.

Overall, I feel both bills address a sorely needed area of Federal Government participation in state and local initiatives. I feel that perhaps a combination of the two bills to provide incentives to the states would be more appropriate.

I, once again, Mr. Chairman, thank you for the opportunity to address the committee.

[The prepared statement of Mr. Kazmarek follows:]

IMPACT
TECHNOLOGIES, INC

Testimony to the Congressional Committee
on Science, Space and Technology
Presented by Joseph C. Kaczmarek of IMPACT Technologies, Inc.
April 30, 1987

Good morning. My name is Joe Kaczmarek and I am President and Chief Executive Officer of IMPACT Technologies, Inc., a two year old software development firm located in Bethlehem, PA. I am pleased to have the honor of addressing the committee this morning on the topic of economic revitalization through technology development and transfer. Today, I would like to offer 2 perspectives in support of my analysis of the two bills in question. The first is from that of a company who has been directly involved with Pennsylvania's economic development program, the Ben Franklin Partnership and Consortium. The second will be from the viewpoint of a company whose business mission is to assist manufacturers in improving their productivity and competitiveness through the application of advanced manufacturing analysis and control technology.

IMPACT Technologies, Inc. started as a concept on a single sheet of Drexel University notebook paper. The IMPACT philosophy centered around solving productivity problems in small manufacturing environments by providing cost effective information systems that are comprehensive enough to be used in even larger environments. IMPACT began on the treacherous journey into the highly competitive software world with no capital and a single personal computer. With the assistance of the Ben Franklin advisory staff, IMPACT was able to launch a local marketing campaign and secure enough contract work to begin funding a large development effort. Subsequent Ben Franklin grants have also assisted in the development effort and provided much needed research work through Lehigh University.

I have been involved with the Ben Franklin Partnership program and the applied research team at Lehigh University since 1984. Since that time, I have seen the scope and magnitude of the program increase dramatically. The program was originally created to encourage research and development interaction between academic institutions and private sector industry and had $1 million allocated for funding the first year. It has now evolved into a $28 million/year program, with over $100 million in private sector matching funds, that not only supports development activities, but also funds "incubator centers" across the state to assist startup companies during their most critical phase. These centers, several of which are actually managed by Ben Franklin itself and housed in a Ben Franklin facility, provide a wide variety of office services and many excellent entrepreneurial assistance programs.

IMPACT is located in one of the Ben Franklin incubator facilities on the campus of Lehigh University. We have received two challenge grants, one for

for each of the last two years. This year, IMPACT is involved with 3 manufacturing firms who have potential projects and will participate in the submission of 4 Ben Franklin proposals for the project year 1987-88. It is largely through the networking efforts of the program and some outstanding marketing direction provided by several of the entrepreneurial assistance programs sponsored by the center that IMPACT has been able to grow to a company of 13 employees with anticipated sales revenues of $1 million for 1987.

Needless to say, these programs work. In this instance, the program has worked not only for IMPACT Technologies, but also for the manufacturing companies who will capitalize on the new technology that we have developed. The program also promotes technology transfer outside of the direct funding arena by encouraging joint ventures and strategic alliances between new technology sources and companies who need a new competitive edge.

Much has been written about the national economy of late, particularly an ever increasing trade deficit and vulnerability to fluctuations in the global economy. The source of this problem is clear: the decreasing competitiveness of American manufacturing with respect to foreign competitors has caused a negative trade in manufactured goods exceeding $132 billion. This deficit can most effectively be solved by addressing the key problem of inefficiency in American manufacturing.

Many companies, professional societies and government agencies have explored the reasons for these inefficiencies and have spent considerable resources studying the business environments of America's largest foreign competitors, especially Japan. Many reasons for foreign superiority were cited: more modern manufacturing facilities and equipment, government policies more favorable to industry support, tighter trade restrictions, and workers who receive a fraction of the pay of the average American factory worker.

Initially, many Japanese manufacturing concepts quickly became the new American buzz words: just-in-time manufacturing, quality circles, etc... American industry responded by investigating ways to implement these Japanese concepts into our manufacturing environments. It soon became apparent that many of the Japanese techniques were inappropriate for the American way of doing business, our geography, and the fundamental American spirit. Over the last two or three years, we have noticed not only an ever increasing loss of our manufacturing position, but a noticeable decline in our ability to design superior cost effective products, particularly in the consumer electronics industry.

This problem is beginning to have staggering implications. From my first hand experience, I talk to customers every month who continue to lose more business to foreign competition. The federal government must act quickly and effectively in order to prevent further erosion. I believe that many of the states and the federal government already implemented excellent programs to stimulate the competitiveness of existing business and the development of new business. These programs are indeed an excellent start. But they are just that, a start.

One of the largest problems confronting businesses wishing to use available technology transfer programs is the lack of visibility of all the state and federal programs available to a particular business. The SBDC comes close to providing this service, but even it does not have complete visibility and understanding of all the programs which may be available. I feel that a referral service of sorts for any business regardless of its size would be extremely helpful in quickly identifying the full spectrum of programs which could help a business with a particular problem or a range of issues.

Many of the existing state and federal programs lack the performance measurement dimension and the requirement of private sector participation in academic institution research. While these programs increase the body of available technical knowledge, without the input of the parties who could ultimately utilize these technologies many of the practical implications and limitations of such research are often ignored. Many programs do not strictly enforce performance criteria, such as private sector matching fund measurement and economic impact measurement. Without a strict insistence upon this requirement, it will be difficult to measure the success or failure of various projects, specific private industries, and academic institutions. Federal funding for technology transfer programs, therefore, should insist on private sector participation and the enforcement of project performance criteria.

Most state funded technology transfer programs have focused on increasing and maintaining business activity within a state. This has put many state programs and businesses from different states in direct competition with each other. This is not necessarily bad since it fosters the continual improvement of state programs with respect to other states and promotes the fundamental philosophy of capitalistic economy: competition. On the other hand, millions of dollars are being wasted on the duplication of technology development in the name of success of state programs.

Additionally, there is a large collective body of knowledge which exists when one considers what each of the state programs has learned about the successes and failures of implementing their state programs. Many programs are not as successful as others simply because they are newer and do not have the benefit of experience that the older programs have. Also, there is a large variation in how each of the state programs operate. With a more detailed exposition of each of the state's experiences, more effective programs would result from application of this collective knowledge.

Several of the state agencies have already recognized this opportunity and have taken steps to encourage cooperation between state agencies through the formation of regional consortiums. An effort is currently underway between Pennsylvania, Ohio, New York and Maryland to develop a regional approach to technology resource conservation, and it appears that this regional approach can be workable. Another argument in favor of the regional approach is that state boundaries are usually arbitrary lines and that functional economic areas very often encompass two or more states. It is my opinion the federal government should take a leadership position in encouraging states to cooperate with each other in the definition of regional strengths and weaknesses as well as the development of regional strategies for improved competitiveness.

But the federal government should go one step further and thoroughly define the American economic problem and how the development of new technologies and the transfer of existing technologies could assist in the solution of that problem. Application of what is termed the "marketing approach" would be extremely helpful. What are America's economic strengths and weaknesses? How do we capitalize on our inherent strengths and improve upon our native or acquired weaknesses?

Technology transfer is an excellent concept and it is working. However, in order to overcome a problem as large as the economic difficulties we face today, I believe that state programs could use direction from the Federal government to focus their efforts on technology and industries which are most crucial in reestablishing our global competitive position. State governments simply do not have the focus or the resources of the federal government to provide such direction. Without it, state programs will continue to benefit industries within a depressed locality, state or a region, but not necessarily an entire industry on a global level.

One additional observation before I provide my opinion of the two bills in question. I have seen technology development and transfer programs help existing businesses stay in business and grow as a result of the the Ben Franklin Partnership Program. I have seen many entrepreneurs like myself take a marketing concept and develop some very elaborate technologies to bring new products and manufacturing processes to fruition. To this extent, existing programs work very well.

But the effectiveness of competitiveness and productivity improvement programs begins with understanding and commitment by business management. I find this to be the weak link in the entire American manufacturing environment. Advanced technologies will help only when corporate management knows how the application of this technology will benefit their company and has a true vision of the corporate commitment often required to make such technology work. Better education of upper and middle management in the benefits and problems of advanced manufacturing technology application is required before this technology can be applied on a more widespread scale.

Upon reviewing the two bills in question, I find that both have considerable merit in attempting to better apply the technology which state programs are helping to develop. However, both bills have strengths and weaknesses and I feel that a blend of the two approaches would be more appropriate. I would like to focus first on the proposed Federal Extension Service Act of 1987.

My understanding of the bill is that it proposes to setup a federal agency under the National Bureau of Standards in cooperation with the National Technical Information Service. This program would be responsible for supporting state funded programs by providing direct advisory and financial assistance, acting as a central source for information about available programs at all levels, encouraging regional cooperation between existing programs, and making foreign technical literature and the service of the Federal Laboratory Consortium more accessible. Additionally, each federal agency which provides industrial extension services shall be responsible for communicating the available services to the the federal IES Director.

My initial reaction to the bill is that it is extremely vague in its intent and implementation. I think the overall objectives of the bill are essential to the improved success of the state programs. However, the details as to how this bill would accomplish these objectives are not very clear. Also, I question the method by which payment is made to state programs in support of the IES. Should a state program which provides $35 million of funding receive the same federal dollar support as a state program which provides $2 million in annual funding? Perhaps a base federal amount proportional to the amount of funding a state provides plus a competitive request for federal amounts above and beyond the base amount according to demonstrated need would provide more state service per federal dollar and encourage creative ways for states to enhance their participation in the program. Also, might $500,000 be too little to start a federal program of this nature?

The Senate bill S.930, the Competitiveness Enhancement Act of 1987 proposed by Mr. Bumpers is somewhat similar to the house bill, but more comprehensive in nature. The objectives of the bill are very clear and the mechanisms by which the program would function are more clearly defined. My interpretation of the bill is that it seeks to establish a new federal agency under the existing Office of Productivity, Technology and Innovation that will focus on the stimulation and enhancement of state and local programs and the improvement of visibility of federal efforts to the state programs.

I feel that the Senate bill effectively addresses several key areas:

1) Like the house bill, it will establish a federal agency to act as a clearinghouse for information about programs at all levels.

2) It provides for a third party evaluation of the effectiveness of individual state and local programs, thereby promoting a more critical evaluation and the sharing of such information between programs.

3) It provides a mechanism by which this program would provide feedback for improvement of existing federal programs.

4) It provides a single source which state agencies can turn to for determining applicable federal programs for a given scenario.

5) Section (f), Generic Research, is particularly interesting. While funding has been available for assistance on individual projects, I feel that monies allocated to studying the range of programs offered by various agencies, their relative successes, and the entire issue of economic revitalization would yield a tremendous return on each dollar. Benefits would be derived at all governmental levels and would stimulate greater creativity in state programs.

6) Section (h) on "Focus of Activities" defines the range of responsibilities and opportunities of the center. In my opinion, this is the most impressive aspect of the bill. It addition to addressing most of the concerns voiced in preceding paragraphs, this section includes other topics in the scope of the Center on State and Local Initiatives. Key enhancements are:

   a) evaluation of programs to foster cooperation between labor and management
   b) assistance in the development of human resources (making the American worker more flexible through cross training programs)
   c) training in entrepreneurship
   d) improving the management of technology

7) The utilization of an advisory board, composed not only of federal members but also of state and local officers and business and innovation leaders will provide a broad perspective and enhance state program and business participation in the program. Use of this advisory board to provide feedback to the legislative process that created it is also an important feature for successful future program enhancements.

Overall, I feel bill S.390 provides an excellent means to begin federal involvement in state technology transfer programs. It addresses most of the key issues and supports the guidelines offered by President Reagan's Executive Order of April 10 "Facilitating Access to Science and Technology".

One key issue which was not addressed in either bill is a reference from the executive order in Section 6, Basic Science and Technology Centers to focus on "research and technology that have the potential to contribute to the nation's long-term economic competitiveness." Again, I feel that while the federal programs should not dictate which technologies should be funded based solely on economic research, it is important that this information be visible to this newly created Center. Used in conjunction with the data collected on state and local programs, a detailed plan for effective technology transfer and economic development could be developed.

Regarding funding, $2 million first year funding appears to be a reasonable amount to organize the proposed center. One concern would be how much of the total monies would have to be expended for compensation of state agencies for their participation in the program. Would the amount remaining be sufficient to accomplish the first year goals?

Perhaps after the formative year, opportunities to capitalize on specific areas of section (h) will become apparent. The bill contains no provision for measuring the success of programs initiated by the center. Consequently, a request for additional funding may be difficult to justify quantitatively. Additionally, instilling performance measurement criteria early in the program will make its implementation and maintenance easier throughout the life of the program.

In summary, I feel that both bills address the critical need for the federal government to obtain and disseminate a collective wisdom on the technology transfer and development process in support of American manufacturing productivity and design excellence. An organization whose objectives would be focused on fostering communications between existing programs will surely make those expenditures more effective. The senate bill provides additional provisions for defining and encouraging a "favorable climate for entrepreneurs" and for improving entrepreneurial skills and the management of technology. Rather than copying the Japanese approach, these bills incorporate those elements of their approach that make sense (regionalization of resources) yet maintain and promote the entrepreneurial spirit in federal laboratories and private industry that has helped make America the country that it is today.

Biographical Sketch

Joe Kaczmarek is President and Chief Executive Officer of IMPACT Technologies, Inc., a private software and consulting services organization supporting the improvement of manufacturing productivity. He has worked as both a development and manufacturing engineer for a variety of manufacturing industries throughout his career and has implemented a variety of computer integrated manufacturing solutions ranging from integrated manufacturing information systems to completely automated flexible work cells. IMPACT Technologies is currently a participating partner in IBM's Marketing Assistance Program and is working with numerous small manufacturers and several Fortune 500 companies in the implementation of the manufacturing systems technology they have developed in conjunction with Lehigh University through Pennsylvania's Ben Franklin Partnership program.

Mr. **Price**. Thank you, and thank all of you for this very fine testimony.

I would turn first for questions to Mr. Boehlert.

Mr. **Boehlert**. Dr. Rhodes, I would particularly like to thank you and the institution you represent for the partnership we have established. You have helped us a great deal, and I also applaud what you are doing with your industrial innovation extension service, and on behalf of my constituents in Courtland, New York, I thank you, too.

What you are doing at Cornell and what is being done in Pennsylvania are serving as models for the program that my colleague, Mr. MacKay and I are developing.

I would like to ask you, Dr. Rhodes and Mr. Kazmarek, the critics of both Claudine Schneider's bill and my bill are arguing that states are already running a variety of programs that no federal involvement is needed.

How would you respond to that?

Dr. **Rhodes**. I would make two comments, Mr. Chairman. The success of the extension program as we have had it for three-quarters of a century depends on a partnership between the states, the Federal Government and county agents.

It seems to me that three-fold partnership has been very important to the legitimacy of the activities, and also to the concern that has been shown about the levels of funding and the range of programs. I would advocate the same kind of partnership now.

I don't think there should be a single federal responsibility. It should have state and local and industrial support, but the initiative to get it going cannot be left to the states. It is the encouragement, it is the legitimacy that federal action would give which would make this grow nationwide.

We have models in place but they are really very inadequate to address the needs that exist. They are on a very small scale and have a very modest reach.

Mr. **Boehlert**. Thank you. Mr. Kazmarek.

Mr. **Kazmarek**. I believe the Federal Government has to start getting involved in helping states administer these programs, not necessarily with large financial commitments, although that would certainly be welcomed, but I think with evaluating the programs that the different states have in place right now—certain programs do better than others in creating and retaining jobs in a region, and creating the technology and facilitation technology transfer.

I think by creating a collective body of knowledge that would be housed in the Federal Government and using this body of knowledge to assist states who want to get programs happening, and to assist states who want to improve their programs, I think this would be an ideal role for the Federal Government to get the program started.

I think once the program has been started, it will evolve into a more comprehensive program that could be integrated with the formulation of economic policy.

Mr. **Boehlert**. You know, we have spent a good deal of time on this seeking expert opinion from the field as we developed the bill—Congressman MacKay and myself, and also Ms. Schneider.

One of the criticisms is that we are thinking too small; they are suggesting that we are not starting with enough money. I noticed you made reference to that, too, in your testimony. Part of the problem is we have a little thing called the Federal Debt, which is about $2 trillion, which means we are spending about $365 million every day, just in interest on that debt. It doesn't feed anybody or clothe anybody, or take care of anyone's ills.

I think there is an urgent and pressing need to be very tightfisted. My thought has been that we would develop something on a pilot basis to see if it worked the way we hope it will work, and then if there is justification for additional funds, to put additional funds in.

Dr. Rhodes, first you—are we thinking too small, and are we doomed from the beginning if we think small?

Dr. RHODES. I would say two things, sir. One is that we have to have a program on a scale that will allow us to judge whether it is workable, and if that meant just one state, I think that would be inadequate. It doesn't have to be all 50 states, on the other hand, at equal intensity. But we must have a nationwide program that reflects the differences, both economical and social that we have, and allows us to judge whether it is workable.

I think that doesn't have to be full-flown in the first instance. The second thing I would want to say is one that you and your colleagues on this Committee know all too well, unless we solve this competitiveness problem, then everything else we believe in is threatened; National security, productivity, economic success, the health and education and well-being of all our people—none of these will survive unless we make this our first priority.

That is why I believe we don't have another ten years to test the experiment. We need to act quickly. We need to act on a small and controlled basis and then develop from what we learn.

The danger, I think, is not spending too much on it, but spending too little in that context.

Mr. BOEHLERT. You are used to dealing in macroeconomics in Cornell. Do you have any magic figure that you would suggest? We are talking in the neighborhood of $15 million. I know that is petty cash in Washington terms, but I am a fiscal conservative, as you know.

Dr. RHODES. I am a fiscal conservative, too, sir. I think that is on the low side, but I would be so happy to work with you in designing a program that might be one that we could test for its usefulness. I think $15 million would be on the low side, though.

Mr. BOEHLERT. Mr. Kazmarek, do you have any observation?

Mr. KAZMAREK. I support a lot of what Dr. Rhodes says, and we certainly understand the concern for conservation for federal dollars. I think in the first year, whenever you try to get a program like this started, and I am testifying on behalf of Ben Franklin's partnership on this, you learn so much in that first year, that if you go much beyond the pilot program, I feel that a lot of tax dollars are going to be wasted.

I think something in the $2 to $5 million for the first year would enable an evaluation of the state programs, and also the formulation of some direction as to how this Center on Productivity or the

Federal Extension Service, whatever you want to call it, could proceed in the following years.

But I think at some point, the Federal Government needs to make a much larger commitment to a program of this nature, once its direction has been established. I think to do that in the first year would be a mistake, but I think that in the second or third year, once its direction is clear and once there is support from the state technology transfer programs, and support from universities, and support from private business, I think that is definitely possible.

I believe, also, that perhaps the Federal program could be structured like many of the state programs in that a lot of private industry would be interested in committing dollars to a program like this, so that not all the dollars would have to come from Federal tax money.

Mr. **Boehlert**. Don't be too concerned about the minimal amount we are suggesting, the $500,000 for activity here in Washington. One of the reasons why I am a Republican, and not, Mr. Chairman, on your side of the aisle, is that I believe that the source of all wisdom is not Washington, DC, and the Federal Government.

I would like to have a lean and mean operation here in Washington, and funnel the money out into the field where it is going to do the most good for the most people.

Do you have a comment, Mr. Geltman?

Mr. **Geltman**. Yes, I do. From our perspective, I think the Center for State and Local Initiatives because it fills a need that we can't fulfill ourselves. It provides us national information. It provides with a clearing house. It helps us with evaluations which unfortunately are not being done right now at the local level.

There are a significant number of very diverse initiatives going on in state government, including in the area of industrial technology transfer. They happen not only in the Cornell model, but there are productivity centers, innovation centers, science and research centers, the engineering research centers. There is a substantial amount of activity going on of a very different nature, depending on the local economy, the local needs, the local setting, the businesses that are involved.

I am afraid a single model just is not very appropriate for 50 states, and that the amount of money that we were talking about, even if we got to the extent—$15 to $20 is probably not going to be significant enough to have a major impact.

I think the important thing, if one wanted to give priorities to the two ideas, is to get some idea of what is happening and what the impact of that is. So that that would be very important. Because of the different activities that are going on are so different, it may not be that in a particular state an industrial extension service is the most appropriate activity.

It may be an incubator center that may be needed; it might be venture capital that might be appropriate. So I am somewhat concerned if we target so specifically, merely on an industrial extension service, whether in every single state that would in fact give us the biggest bang for the buck.

I think we would opt towards flexibility for state and local experimentation which is going on, coupled with some idea of what is happening with the funds that are already being expended, which are very sizeable indeed, from both the Federal and the State Governments.

Mr. Boehlert. You know, as we sit and confer at this very moment, a great debate is going on the Floor of the House on how best to come to grips with the trade deficit crisis. I have participated in that. I was a supporter of the Gephardt Amendment yesterday, among other things, and I am deeply involved.

Despite all they do over there, I am absolutely convinced that the best way to solve the deficit crisis is to use the scientific and engineering genius of America to the maximum. We have to get it out there.

At Cornell, they have more Nobel Laureates than I have neighbors on my street. We have the genius and we have to get what they have to offer out into the marketplace, and to the manufacturing facilities, to the Rubbermaids of the world, and I think this industrial extension service is the opportunity and I want to seize it.

I want to thank all of you for your expert testimony, and also for the pleasure of your cooperation, and willingness to be so helpful to us.

Thank you.

Mr. Price. Ms. Schneider.

Miss Schneider. I have a number of questions, but let me begin by welcoming Dr. Rhodes, with whom I had the pleasure of serving on the Business Higher Education Forum in an effort to address the whole question of competitiveness, and so I am delighted that my colleague, Mr. Boehlert, had the foresight to include you in these hearings today.

I think that I would like to continue along some of the same lines that he was mentioning insofar as the criticism that we have received on the proposed legislation.

One of the comments you made is that you have engineers that go out into the community, into the counties, and attempt to resolve some of the technological challenges that businesses and industries might have.

One of the criticisms has been, why should the Government get involved in this process? Why couldn't this be something that private consulting firms, engineering firms could be doing, and are we not taking work from the private sector?

How would you respond to that?

Dr. Rhodes. I welcome the question because we have struggled with this one, too, Ms. Schneider.

I think it is not either or; I think it is both. Let me give two simple examples. I talked about the program we call PEWS, the program for employment and workplace study systems.

That receives $200,000 a year from the State of New York. That is a modest amount, even by New York State's standards. But that money formed the basis, for example, of preserving 894 jobs, at Trico that I just talked about. That is a very small state investment for the gain it ultimately makes in keeping that number of people employed on the basis of their contributions, both as citizens and as taxpayers.

The other example I quoted, the one where we have been involved in everything from computer-assisted manufacturing, to injection molding, that runs with an equally small grant from the State; $146,000 a year. That employs two full-time engineers, going out on the circuit. But the small businesses and the industries, themselves, make a contribution.

What that does is provide a slender kind of infrastructure, that provides the consulting services which is then reimbursed by the firms, themselves. That can be up to $1,000 a day for established companies; lesser amounts for smaller ones.

We think that kind of partnership, a three-fold partnership there between the state, industry and Cornell University, is one that is a useful model for Federal involvement in the same kind of program.

I don't think that we have the opportunity any more to leave it all to industry because we shall suddenly find that all the jobs have gone offshore with the products, if we do.

Miss SCHNEIDER. Okay. Thank you, very much. One of the frustrations that we have had through the last six years or so is that the agricultural extension programs have been under attack by the budget cutters. So to have an extension service of this type has also, whenever we propose a new idea, there is always the challenge of—well, wait a minute. We just want to hold onto the old programs. We don't want to extend and start something new.

I think that the testimony of all three of you very clearly states why we need to have this legislation, that Congressmen Boehlert and MacKay are promoting, that I question the expansiveness or lack of expansiveness of it. As you were speaking, one of the ideas that came to mind was the Coastal Zone Management Program. I don't know if you are familiar with it or not, but in order to obtain Coastal Zone monies, you had to fulfill various qualifications in terms of putting together a plan as to how those monies would be used to determine whether certain coastal areas would be developed or used for conservation purposes.

Obviously not all states were eligible because they didn't have coasts, so that cut out a certain number, and then the second cutoff came when there were a number of states that were just not interested in a thoughtful planning process, so they did not apply.

Do you think that perhaps, and of course we are going for the whole thing, but we always need a fall-back strategy; do you think that it might be a good idea to have such criteria that would say in order to qualify for the extension service program, that it would have to be shown that there is either a partnership clearly established between state, local and university sectors, or something of that nature?

Dr. RHODES. I think that is a very appropriate way to make the selection. I don't think you can go full bore with all 50 states in the first instance. I believe you need to be selective. You want one at least in the Southwest; you need a couple in the Northeast; you need several in the Midwest, and so on.

I would guess the most promising way to select those is to look for two things. One perhaps is their willingness to match the Federal funds that you offer. A second one is the capacity to serve as a model, and that would mean not only a network, which I think you have to have—a computer and satellite network—but also a land-grant university that is willing to serve as the focus for this.

That seems to me to be a very appropriate way to go.

Miss **Schneider**. Okay. Mr. Geltman, I would like to ask you a few questions about by own bill. Traditionally, states' economic development has focused on luring different businesses and industries from other states, and I wonder if this still the primary focus of various states, or are they looking more at revitalizing mature industries, and trying to develop new ones?

Mr. **Geltman**. Until recently, industrial recruitment was the cornerstone of most state economic development programs, but that has changed. We recently conducted a survey, and the survey responses indicated that states continue to promote themselves as a good location for business, but in most instances, such promotion efforts are now part of a comprehensive development effort that includes assisting existing businesses, and encouraging the formation of new businesses.

Only two states reported an increase in recruitment activities during the last ten years. 19 states, however, said that there had been an increase in the overall level of economic development, including marketing and promotion activities.

Ten of the 19 states are Western states, and another five are Southern.

In summary, I think there has been a major shift, by adding additional resources into economic development, and not in the recruitment area. They have been getting very much more heavily involved in promoting entrepreneurialism, promoting technology transfer, providing technical assistance of both the industrial recruitment variety, as well as management assistance, promoting labor management improvement—a large number of activities, a number of which are contained in your bill in terms of what ought to be evaluated that will assist states in continuing to refine their activities.

Miss **Schneider**. Well, one of the other concerns that I have, and since I am playing Devil's Advocate for these two pieces of legislation, since the three of you gentlemen seem to think both bills are such a good idea—the Office of Productivity, Technology and Innovation has a small effort already ongoing with state efforts.

I wonder if your assessment of this is adequate or not adequate?

Mr. **Geltman**. I would say from my perspective, it is inadequate. There are two few people in an under-funded office.

Miss **Schneider**. What do you think that the state and local governments have to offer that can't be duplicated by the Federal Government?

Mr. **Geltman**. I think one of the things that the states and local governments are best able to do is in fact work directly with universities, and work directly with the private sector.

The Federal Government is very good at macro policy. It is very good at data collection. It can perform as a third-party outside advisor and evaluator, but I don't think it is probably very good at, in fact, providing assistance right where the action is. Nor, is it very good at experimenting.

I mean, you will try to develop a model and provide some kind of a uniform standard nationwide. I think what we need now is a lot of experimentation. I think the states have taken initiative over the last five years, and are exploring large numbers of areas to find out what we can do to improve competitiveness. That is something the states can do much better than the Federal Government can do.

Miss SCHNEIDER. My one last question to Mr. Kazmarek. You had mentioned the Ben Franklin Institute in Pennsylvania insofar as being effective in technology transfer. There was a proposal some time ago called Eco Rock, which would take all of our urban sewage sludge, turn it into a rock material, then into an asphalt that I understand was used to pave many of the roads in Eastern Pennsylvania, and would certainly put a lot of state governments back in the black insofar as their highway expenditures were concerned.

Somehow or other, this technology did not go beyond Franklin Institute. I just wondered, you are working with them; do you think that the process that they have is a good enough model for technology transfer?

Mr. KAZMAREK. I can't comment directly on that project because I am really not aware of the details. However, I do think that the Ben Franklin has some very key elements that make it the successful program that it is.

Miss SCHNEIDER. What are those key elements?

Mr. KAZMAREK. If the companies commit to matching dollars; they must match those dollars and they must report on what dollars were actually committed, or the likelihood of getting the project funded the subsequent year is going to be drastically reduced.

You also must document jobs that are created or retained, and these used to be tri-annual reports. They are now semi-annual reports that we submit to the state that document how many jobs were actually created and maintained.

The Center then maintains a complete project history and a complete industry profile on your business as to how well you have met what you have committed to, and obviously companies and projects that succeed in exceeding those commitments are more likely to get better funding the following year.

So I think in using your example, although there is no direct way to research every project to make sure that each project has met its goal, I think that there are some excellent mechanisms in place to accomplish that.

Miss SCHNEIDER. Thank you, very much.

Mr. PRICE. Thank you. Mr. Ritter.

Mr. RITTER. Thank you, very much, Mr. Chairman. I really don't have any questions. I apologize to President Rhodes, Dr. Geltman, and my own constituent, Bob Kazmarek, for not being here. We were setting up all morning a conference on superconductivity, which has Neil Ashcroft from Cornell, as well as the superstars of this new super field.

But I do apologize, and I just want to put in a word for the Ben Franklin Partnership. Governor Dick Thornburgh, who initiated this partnership, was prescient. I think he developed perhaps the finest state private sector program in the country. The new governor, Bob Casey, has taken it in hand and seeks to build it, foster it, nurture it, and I think we are doing quite well.

I appreciate, in looking at your testimony, Mr. Kazmarek, I feel that you have some excellent contributions to make and as the Chairman of the Republican Task Force on Technology and Competitiveness, as well as a Member of this distinguished Subcommittee, I would like to further develop our relationship because I think you are hitting some nails right on the head in your testimony, and I think we can take further advantage of your skills.

I thank you, Mr. Chairman, and I yield back the balance of my time. If anybody in this room is interested, in 1100-Longworth, in the Ways and Means Hearing Room, a very splendid hearing on superconductivity is about to unfold. Essentially, it looks towards not only what is happening, but what should be the American response as this break through becomes more and more apparent, and its potential impact on the way we live becomes more apparent.

Thank you, Mr. Chairman. Thank you, gentlemen.

Mr. PRICE. Thank you.

The various proposals in this area seem to offer two options as to where this program would be housed, either at the National Bureau of Standards, or at the Office of Productivity, Technology and Innovation in the Department of Commerce.

I wondered if any of the three of you would have a strong opinion as to which administrative arrangement would be preferable. Do you have experience with either of these agencies that would lead you to strong preference?

Dr. RHODES. Mr. Chairman, I don't and I can't be very helpful in that sense. I would only suggest respectfully that there might also be other options that you would care to examine as a committee.

Mr. GELTMAN. I think we have had a very successful working relationship—that is, the states—with both the National Bureau of Standards and OPTI. I think our preference would be OPTI because I think we are looking for a little bit broader focus in terms of the efforts for the two bills. OPTI seems to work very closely with the National Technical Information Service, as well as other departments. It might make a little bit more sense, given the broader focus, to put it into OPTI.

Mr. PRICE. All right. Mr. Geltman, I wonder if you could tell us how many states are now operating some kind of industrial extension program. Do you have any systematic information on the range of state programs, the average funding levels; whether they are based mainly at universities or in other settings; what kind of fees they charge? That kind of basic information about the range of state programs.

If you don't have that at your fingertips, I wonder if you could furnish some kind of tabular summary for the record.

Mr. GELTMAN. What we do have is a book that we released in August of last year, which I referred to in the testimony, which was called "Revitalizing State Economies."

In that book, we examined the range of new state economic development initiatives. We have in there a list of some programs which operate as if they were industrial extension services.

The problem is to identify them because they go under different names, they are located in different kinds of agencies, and it is difficult to compare them. You don't know whether you are comparing apples and oranges.

I think what I would like to do is give a volume of the book to the record, or however you would like to do that and be glad to sit down with staff and work with them in providing you with the information that you need that we have available to us. We do have a staff person who has been working in this area and can provide some assistance to the Committee.

I think the answer in the most limited stage, is that there is maybe a half a dozen or more that seem to be doing what you would call industrial extension services.

Mr. PRICE. Half a dozen states.

Mr. GELTMAN. But there are many more which are very involved in helping industry in all sorts of ways with management assistance, sometimes with financial assistance; sometimes with housing, through incubators, and with those incubators comes some other assistance, as well.

But I would be glad to work with your Committee staff to provide you the information that we have.

Mr. PRICE. Fine. Could you generalize about the relations the state programs have had with the Federal laboratories, and other agencies of the Federal Government? What kind of information do they most need from the Federal Government? What kind of programs do they take advantage of? What has the experience been? Is it possible to generalize about that?

Mr. GELTMAN. I can only generalize about that. I don't have specific information. We have been working with the State Science Advisers and Technology Program Administrators. The record it seems with Federal laboratories has been very spotty. There seem to be instances where particular laboratories are working very hard to work with state agencies on transfer.

Illinois, as a state, seems to be working very closely with the four laboratories in Illinois. My understanding is that in Eastern Tennessee, there are several laboratories there that are working fairly closely with the State of Tennessee.

There are instances where there is an Air Force Base in Ohio, which is working very closely with the State of Ohio in its technology transfer program. I can't remember how many Federal laboratories there—200 or 300, as I recall, maybe it is more.

But my recollection is that there are 15 or 20 that seem to have, at most, working relationships with the state and maybe 5 or 10 where there is a very close relationship, and there might actually be some technology that is being mutually transferred through Federal, state and industry partnerships.

Mr. PRICE. What kind of experience have the states had in learning from one another? What have been the main means for sharing information among these various state programs? Would you say that rivalry between the states has hampered the flow of information?

Could you generalize about that?

Mr. GELTMAN. Let me answer the last question first. I think in general, when states concentrated on industrial recruitment as an economic development strategy, there was a tremendous amount of rivalry. While there is still industrial recruitment going on, that is becoming less and less the major driving force of the state economic development issues.

The remaining kind of activities, people are seeing not so much competitiveness as helping, for the most part, their existing and new businesses grow. To the extent that they continue to concentrate and expand on those efforts, they are very interested in sharing their ideas with fellow states.

Over the last year and a half, we have had three meetings, approximately every six months, of State Science Advisers and Technology Program Administrators whose primary purpose has been to share information, to bring in not only examples of what they are doing, but the problems they have with it, how they are evaluating the programs, and so on.

The State Economic Development Officials have been getting together for a long period of time, particularly on what to do on financing programs and the like. It seems to me that there is more cooperation going on then there ever has been before. And that, I think, is in conjunction with the diminishment of recruitment as a strategy.

Mr. **Price**. Dr. Rhodes, if we could turn to you for one last question. I think one of the most useful features of your testimony was the offering of these specific examples of what you have been able to do.

I wonder if you could say something about the extent of faculty interest that you have detected. Has it been easy to get faculty involved in these programs, and then on the other side, the extent of industrial interests—the businesses in your state. Are there particular kinds of businesses that have been more responsive than others, and again, that question of outreach.

How is it that you have stimulated interest, and to what extent has it been necessary to really promote this kind of program with the business community?

Dr. **Rhodes**. Mr. Chairman, let me give a very candid reply. 15 years ago it was almost impossible to interest most faculty members in anything outside their own classroom and lab. That has changed and the pattern of cooperation with industry that I just described is one that is growing increasingly important, not just for industry but also for the universities.

We have always had strong consulting ties between our scientists and engineers and major corporations—the IBMs, the General Electrics, and the AT&Ts; those are well established and they have been very effective for both sides.

What we have been unable to do is to develop a structure where a small corporation, a new growth industry, a new venture capital of some kind could have some way of breaking into the same system, of making contact with faculty members who had the expertise to help them.

Now that we have a very modest office that sponsors this kind of partnership, faculty interest has been growing and growing remarkably well. It is not going to be something that is instantaneous, that we get all our faculty members aboard. But I am convinced that if we could put the structure in place, we have the faculty willingness and interest to take part in it.

Where that has been tapped, and used, the results have really been dramatic. I picked out two that happen to be easy to describe. I could give you another half dozen that are equally impressive in terms of the results. I think there is much to encourage us there, and the faculty, I believe, are willing to help, if we can put the structure in place.

Mr. PRICE. Would you care to comment on the degree of business interest?

Dr. RHODES. That has been very strong, both on the part of the established corporations, and on the part of smaller corporations. The big question that comes to us again and again from the smaller corporations is, how do we know where to turn for help? By having something as simple as a pamphlet and circulating printed lists of faculty interest and expertise, we have had a remarkable response from small businesses.

It is the small businesses who are not plugged into the system, and it is those businesses which are the new growth areas which most need the kind of help we can give. It is modest help. It is not a four-year consulting contract with ten individuals. It is expertise in specific areas that can often be given in a day or so, but it is making contact between the expertise and the need that is the thing that we have to strengthen.

Mr. PRICE. Good. Thank you. We thank all of you for some very enlightening testimony and for your forebearance in waiting around today. We appreciate very much hearing from you.

Now, our long-suffering Panel Number Four we will call, with profound apologies for the delay. I do believe we have time to hear from you, and we hope we can explore your views fully.

Our panel consists of two gentlemen, Mr. George Dummer, the Director of the Office of Sponsored Programs at Massachusetts Institutes of Technology in Cambridge. Mr. Dummer is representing the Council on Government Relations. Also, Mr. William Carpenter, of the Martin Marietta Energy System, in Oak Ridge, Tennessee.

Gentlemen, we are glad to have you with us today and we will be glad to hear from you. Mr. Dummer.

Mr. BOEHLERT. Before Mr. Dummer, let me also add my apology. We don't do a very good job of managing your time. It is very important and I am really very sorry that you have had to be here so long.

We look forward to your testimony and I just want you to know we are going to try to improve in the future in terms of giving you a better idea of just when you might be on.

Mr. PRICE. Yes, we have had five panels this morning, all of them worthwhile. But it has just been more than we have been able to deal with in the time allotted.

Mr. Dummer, we will be happy to hear from you.

STATEMENTS OF GEORGE H. DUMMER, DIRECTOR, OFFICE OF SPONSORED PROGRAMS, MIT, CAMBRIDGE, MA, ACCOMPANIED BY JOHN PRESTON, DIRECTOR, TECHNOLOGY LICENSING OFFICE, MIT; AND WILLIAM CARPENTER, MARTIN MARIETTA ENERGY SYSTEM, INC., OAK RIDGE, TN

Mr. **Dummer**. Thank you, Mr. Chairman. I would like to note at the outset that I am accompanied here by Mr. John Preston, on my right. John Preston is the director of the MIT Technology Licensing Office, which I will refer to briefly in just a moment.

As you mentioned, Mr. Chairman, I am speaking on behalf of the Council on Government Relations, an organization of more than 120 colleges and universities, which are engaged in a broad spectrum of federally and privately funded research programs.

The Chairman invited my comments today with respect to the President's Executive Order of April 10th, and to the particulars and/or general issues which it addresses. I would like to respond by focusing on one very important particular, namely Section 1(b)(6), which provides "for the development of a uniform policy permitting federal contractors to retain rights to software, engineering drawings and other technical data generated by federal grants and contracts, in exchange for royalty-free use by or on behalf of the Government."

We strongly endorse the development of such a policy. Without it, the contribution which the Government-university-industry relationship makes to this country's competitiveness will not achieve its full potential.

Government funding of university research provides a rapidly growing pool of research results with a potential for early industrial application, particularly as new technologies are created directly out of basic research, such as lasers, optic fibers and integrated circuits and the biotechnologies.

Dr. Graham referred earlier this morning to the break-throughs in superconductivity around the world. Quite recently we have read that Prof. Chu at the University of Houston has achieved superconductivity at 283 degrees Fahrenheit.

Suddenly superconducting materials make it economical to create tiny, super-fast computers, magnetically floating trains, and long-distance power lines that waste no energy. Scientists around the world are reportedly eating and sleeping in their laboratory as they try to jump into the lead in applications and commercialization in a new and exploding market.

In this fast moving environment, we must ask ourselves what is necessary for the rapid and successful transfer and commercialization of this and other technology created out of university research funded by the Federal Government. There are obviously many answers because many elements are essential to the transfer process. One of them, however, is a Government policy which, first of all, provides at the outset, and not by request and waiver from the Government, that the ownership and the right to disseminate the research results and transfer the technology remain in the university which created it, if it so elects.

A policy which, secondly, provides that the rights acquired by the Government are adequate to meet essential Government purposes, but not so broad as to inhibit the transfer of the technology or discourage industrial companies from investing in its further development and commercialization.

The Government has, at least in part, had such a policy since 1980, when Public Law 96-517 gave nonprofit organizations and small businesses the right to own and to commercialize patentable inventions resulting from federally funded research grants and contracts.

In my view, Public Law 96-517, and the amendments of Public Law 98-620, have had a significant and positive impact, starting with the elimination of some 26 different federal patent policies, many of them involving the cumbersome waiver procedures which large business contractors find so troublesome today.

In addition, Public Law 96-517 has facilitated stronger research relationships between universities and industry. It has also encouraged the creation or expansion of university activities directed toward the transfer of university-generated technology.

I should note at this point that the MIT Technology Licensing Office, which Mr. Preston directs, is typical of the kind of activity in which a growing number of universities are engaged, an activity which involves the transfer of technology by individuals with technical backgrounds and business experience, who understand both the technology and the complications of transferring it to the commercial sector.

As universities have become more active in technology transfer, however, it has also become increasingly obvious that the effective transfer of university-generated technology requires dealing with a combination of intellectual property rights.

For example, a number of universities, including MIT are now working on nuclear magnetic resonance [NMA] imaging devices because, unlike the x-rays used in CAT scans, magnetic fields have no known toxic side effects. But to achieve the accuracy of CAT scanned images requires a sophisticated and integrated hardware and software system.

Another example is symbolic processing, the backbone of artificial intelligence technology. Developed at MIT, it consists again of a combined hardware and software system which allows computers to simulate human problem solving and data processing techniques. The hardware design and its software, which MIT has named LISP, has been licensed to various companies, and LISP circuits are finding their way into many new applications.

Finally, one of the best examples of technology which embodies multiple property rights, is an integrated circuit, which may involve a copyrightable pattern generating software program, a chip design copyright under the new semiconductor Chip Protection Act of 1984, a patent on the novel functions performed by the integrated circuit, and very possibly a trademark.

The consequence is that not only does the effective transfer of university-generated technology require dealing with a combination of intellectual property rights, it also requires a federal policy for technical data and software which parallels that for patentable inventions and thereby permits the transfer of the technology in a coherent manner without regard to the forms of legal protection involved.

Such a policy would also recognize that technical data and software, in particular, are most effectively transferred by their authors and creators. Software is normally in a state of continuing development and enhancement. Its successful dissemination and commercialization frequently require the continuing involvement of the original authors who created and understand its architecture and the intricacies of its source code.

However, as elaborated in my prepared statement, current federal policies with respect to technical data and software are not consistent with Federal policy governing rights in patents. Furthermore, Federal rights in technical data and software are determined on the basis of criteria which are exceedingly difficult to apply given the nature of university research.

In addition current Federal agency regulations can inhibit the conduct of university research and the dissemination of the results particularly those regulations which reflect the view that it is the prerogative of the federal sponsor to disseminate through its own distribution program the technology created by its contractors.

We therefore endorse Section 1(b)(6) of the April 10th Executive Order and recommend that any uniform federal policy provide first that the ownership of software and other technical data remain with the contractor; second, that any rights which the Government obtains to technical data or software be limited to rights and data specifically required to be delivered or prepared under the terms of the contract or grant; and, third, that the Government acquire a royalty-free license to use such technical data or software for specific Government purposes, but not including the right to use it in a manner which would inhibit the transfer and commercialization of that technology by the university which created it, or by that university's licensees.

Thank you.

[The prepared statement of Mr. Dummer follows:]

COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

U.S. HOUSE OF REPRESENTATIVES

WASHINGTON, D.C.

FACILITATING ACCESS TO SCIENCE AND TECHNOLOGY

BY

GEORGE H. DUMMER
DIRECTOR, SPONSORED PROGRAMS
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ON BEHALF OF THE COUNCIL ON GOVERNMENTAL RELATIONS

APRIL 30, 1987

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My name is George Dummer and I am the Director of the Office of Sponsored Programs at the Massachusetts Institute of Technology.

I am speaking today on behalf of the Council on Governmental Relations, an organization of more than 120 colleges and universities engaged in a broad spectrum of federally and privately funded research programs.

My purpose is to address Section 1(b)(6) of the President's April 10 Executive Order on "Facilitating Access to Science and Technology," which provides for development of a uniform policy permitting Federal contractors to retain rights to software, engineering drawings, and other technical data generated by federal grants and contracts, in exchange for royalty-free use by or on behalf of the government.

Such a policy could have a very direct and favorable impact on the ability of the nation's colleges and universities to play an effective role in transferring to commercial application the research results and technology developed in the course of Federally funded research.

Our reasons for endorsing it are as summarized immediately hereafter and set forth more fully in the pages which follow.

I. The Impact of P.L. 96-517 on Technology Transfer

The passage of P.L. 96-517 and P.L. 98-620, giving universities and small businesses the right to own and to commercialize patentable inventions in the public interest has:

- encouraged the creation or expansion of university activities directed toward the transfer of university generated technology; and
- facilitated stronger research relationships between universities and industry.

Since 1980, my own institution has gone from $13 million in industrial research funding to $36 million in 1986. There are a number of reasons for this, but there is no question that P.L. 96-517 has greatly facilitated the negotiation of research agreements with industrial companies.

The same situation exists today with respect to computer software and other technical data as existed for patentable inventions prior to 1980. Industrial companies are reluctant to fund the development of software at colleges and universities when a Federal agency is in a position to deny the university the right to copyright, release, or distribute the software or when the government retains the right to make it available to all comers through its own software distribution center.

These activities have in turn demonstrated that:

- **The effective transfer of university generated technology requires dealing with a combination of intellectual property rights under a Federal policy which is the same for technical data and software as for patentable inventions.** For example, an integrated circuit may involve a copyrightable pattern-generating software program, a chip design copyright under the new Chip Protection Act, and a patent on the novel functions performed by the integrated circuit, and very possibly a trademark.

- **Technical data, and software in particular, are most effectively transferred by their authors and creators.** Software is normally in a state of continuing development and enhancement and its successful dissemination and commercialization frequently requires the continuing involvement of the original authors who created and understand its architecture and the intricacies of its source code.

II. Present Federal Policy Is Incompatible With University Research

There are a number of characteristics of university research which must be considered in the development of Federal policy on technical data and software, but which are not reflected in current DOD or in proposed civilian regulations.

- Research is a continuum where research teams over time build data bases and develop software.

- Contrary to common belief, the most basic, generic research does sometimes yield results which have immediate application or form the basis for new technology, and the most applied research can contribute significantly to an understanding of basic phenomena and advance the state of the art. This phenomena is likely to occur more frequently, as new technologies are created directly out of basic research, such as lasers, optical fibers, integrated circuit chips, and the capacity to select and relocate microbial, bacterial and human genes.

- University research projects generate reports and studies that rarely involve the delivery of technical data for hardware systems. Nor does such research involve competitive procurement or reprocurement of hardware or supplies.

- Software generated on university research projects is frequently developed solely as a tool to facilitate the research and is unrefined and not susceptible to use or distribution by others.

- University research teams are quite commonly supported by multiple public and private sponsors over a period of time and also receive support from university funds.

In view of these characteristics, and the consequent difficulty inherent in identifying and segregating data based on source of funding, it is not realistic or practical to determine Federal rights on the basis of source of funding or procurement specifics which is the present basis for Federal policy, i.e.;

- Whether the resulting item or process has been exclusively funded by the federal government or is required for competitive procurement.

- Whether the data has been produced, generated or specifically used in the performance of the contract without regard to whether or not it is related to specific items or processes or whether or not it is specified to be delivered or prepared under the contract.

III. Federal Rights Can Inhibit University Research and Technology Transfer

Under existing Federal regulations, government rights, even when they are "limited" or "restricted" can impede the conduct of the research and dissemination of the research results by university.

- Federal agencies are given the discretion to decide whether universities should have limited or blanket permission to copyright technical data resulting from research and prior approval of the Contracting Officer may be required before the university can establish claim to copyright, publish or release to others computer software first produced in the performance of the contract.

- Federal agencies may require the delivery, with restricted rights, of any proprietary software used in the course of federally funded research, including that provided under standard licenses from commercial vendors. This inhibits the use of such software where vendors feel that it is inequitable for the government to thereby acquire the free use of their software.

IV. Recommendations for Federal Policy on Technical Data and Software

The effective transfer of university generated technology requires the development of a government-wide policy on rights in technical data and computer software which parallels that adopted for patents and which permits the transfer of technology in a coherent, integrated manner without regard to the forms of legal protection involved.

We endorse Section 1(b)(6) of the April 10 Executive Order and recommend that the uniform Federal policy provide that:

- The ownership of software and other technical data remain in the contractor.

- Any rights which the government obtains to technical data or software be limited to rights in data specifically required to be delivered or prepared under the terms of the work statement, reporting requirements, or specifications of the contract or grant.

- The Government acquire a royalty-free license to use such technical data or software for specific government purposes, not including the right to license it for commercial purposes or to otherwise permit its use by the government or its contractors in a manner which might inhibit the transfer and commercialization of the technology by the university which created it, except as mutually agreed.

I. THE IMPACT OF P.L. 96-517 ON TECHNOLOGY TRANSFER

The passage of P.L. 96-517 in 1980 marked a turning point in Federal policy by giving nonprofit organizations and small businesses the right to retain ownership and control the licensing of patentable inventions resulting from Federally funded research in order to encourage the transfer of technology to the commercial sector and improve this country's capacity to innovate and compete in world markets.

Facilitating University/Industry Research Relationships

Prior to P.L. 96-517 many industrial companies were reluctant to support university research in areas of concurrent federal support. There were a variety of federal policies with respect to rights in inventions, and in many cases there was no assurance that the university would be permitted to retain title and license the industrial sponsor on an acceptable basis. Where rights could only be acquired by a time consuming waiver process, there was no certainty of success.

After the passage of P.L. 96-517, when the universities were in a position to retain title to inventions resulting from Federal projects and license them on reasonable and predictable terms, industrial companies showed significantly more enthusiasm for funding research in areas of Federal interest and taking advantage of the opportunity to acquire license rights and reduce to practice those inventions which were conceived with Federal research funding.

Expansion of University Technology Transfer Activities

With the impetus of P.L. 96-517, many of our member institutions have broadened existing technology licensing programs or established new ones.

One interesting indicator, for example, is that the Society of University Patent Administrators (SUPA) has grown sevenfold in the last seven years. SUPA and the National Council of University Research Administrators (NCURA) have conducted national and regional meetings featuring an increasingly broad range of presentations and workshops on all aspects of the technology transfer process. These include changes in patent and copyright law, government policies with respect to patents and technical data, the updating of university policies to meet changing conditions and technology, the negotiation of intellectual property provisions in university-industry agreements, and the licensing of university generated technology.

Transfer of Technology Involving Multiple Property Rights

As universities have increased their technology licensing programs, they have discovered that to deal effectively with technology transfer they must be prepared not only to deal with patentable inventions but also with technical data and computer software.

It has become increasingly clear that the effective transfer of many forms of technology will require dealing simultaneously with patents, copyrights, trademarks, the new Semi-Conductor Chip Protection Act, or other forms of proprietary rights.

Technology Is Transferred Most Effectively by its Creators

P.L. 96-517 recognized that effective transfer of patentable technology did not result when patents were acquired by the Federal government and offered for licensing to anyone on the mailing list, without comment or interaction from those responsible for the invention. This is no less true of technical data, and computer software is perhaps the best example.

An institution which has established an effective program for the dissemination of data in computer software form is in the best position to evaluate the software and choose the manner in which that can best be achieved. In some cases it may require putting the software in the public domain. In others it might be licensed to end users with the technical expertise and willingness to invest in the development of in-house applications, or to a software house to enhance, debug, license and maintain it for multiple licensees.

II. CURRENT FEDERAL POLICY IGNORES THE REALITY OF UNIVERSITY RESEARCH

There are a number of characteristics of university research that must be taken into account in the development of a realistic and workable policy on rights in technical data and software. They are not, however, recognized in current Federal data policy.

Research Is a Continuum

The field of research in which a faculty member specializes tends to be his or her long term professional interest and the members of the research team, including the students, are those who share that interest.

In performing research, including that funded by third parties, the faculty members follow their own interests and agendas. The research, therefore, tends to be a continuum which builds a base of experimental results and data which, over the years, is expanded, refined, and perhaps integrated with other research results in an interdisciplinary environment.

Universities do not conduct research projects in the same manner that a consulting firm might respond to a client who defines the project he wishes undertaken. The university research team is not assembled to conduct a sponsor-initiated project and disbanded or reconstituted for the next assignment when that one is completed.

The university research team is already in place, pursuing its own agenda. What it agrees to do in accepting Federal or private research funding is to devote some portion of its total effort, for a stated period of time, to applying its cumulative experience and expertise to a particular problem or application which is of interest to the sponsor and gives the university research team an opportunity to advance the state of the art.

Basic and Applied Research Are Often Indistinguishable

In recent years, the innovation cycle from university laboratory to commercial application has in many fields been so compressed that the distinction between basic and applied research has become blurred. This is true not only in the engineering schools but in the science schools as well.

On February 15, for example, when the University of Houston announced that Professor Chu had achieved the latest breakthrough in superconductivity, it triggered a world-wide race to develop the commercial applications, ranging from superconducting computer chips to magnetically floating trains and long distance power lines that waste no energy.

Deliverables Are Normally Research Reports and Studies

University research projects generate reports and studies and rarely involve the delivery of elaborate technical data for hardware systems or for the competitive procurement of hardware or supplies. It should also be noted that product development falls outside the scope of university activities.

Development of Software

University researchers use a broad range of software licensed from commercial vendors as tools in the conduct of their research. In addition, they generate programs of their own for the same purpose in connection with their research grants and contracts. Such software is usually unrefined and not susceptible to dissemination through the software distribution centers maintained by Federal agencies.

Research May be Multi-funded

A faculty member's research, over its life or at any given point in time, is likely to have received support from both federal and private sponsors as well as from university funds.

In addition, both graduate students and post-doctoral researchers with their own fellowships or other sources of support may have participated in the research without cost to the Federal grant or contract, and the academic salaries of faculty working on research grants and contracts may very well have been funded by the university.

The consequence is that there are very few research results that are exclusively funded by any one sponsor or source of funds.

Determining Federal Rights by Source of Funding Is Unworkable

In view of the nature of university research and the multiple sources of its funding, the most difficult basis on which to determine the relative rights of the parties is to base it on the source of funding.

Under current regulations, one criterion for determining Federal rights is whether the item or process was developed exclusively with Federal funds. More commonly, however, Government rights apply to all technical data which is first produced or generated in the performance of a contract.

In addition, some agency regulations provide that the Federal government acquires rights to data "specifically used" in the performance of a contract.

It is a formidable task to identify "all data produced" or "specifically used" in the performance of basic and applied research, particularly that which is not related to specific products or processes and is not specified in the contract for delivery.

FCCSET Statement

The difficulties inherent in identifying and segregating data are noted in the February 25, 1985, version of a policy statement with respect to data rights drafted by a subgroup of the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET). Although the policy was apparently never adopted, the statement was eminently realistic from a university standpoint:

> "..it must also be recognized that in many cases the data will build upon past experience, expertise, know-how and organizational abilities which the contractor or subcontractor brings to the project. As a practical matter, it is not likely that a meaningful segregation can be made between the know-how and expertise generated under the contract and the know-how and expertise which the contractor previously possessed and applied to the contract."

This is particularly true of software, which is constantly being developed, refined, debugged, enhanced, used for derivative works, and issued and reissued in successive releases.

III. FEDERAL RIGHTS CAN INHIBIT UNIVERSITY RESEARCH AND TECHNOLOGY TRANSFER

Current agency policies for determining rights in non-patentable research results are inhibiting the conduct of research at universities and the dissemination of university research results and publications.

Restraints on Copyright and Software Dissemination

One of the distinguishing characteristics of the university environment is the imperative to publish and disseminate the results of research and other scholarly effort.

Student's must publish their theses in order to obtain academic credit and faculty research investigators must expose their ideas and the results of their research to their peers for critical review, discussion and verification. Otherwise, they cannot acquire or maintain their professional standing, attract the best students, or stay on the cutting edge of their disciplines.

Since the technical reports and other published results of their research are the professional output of the authors, the conclusions reached must be their own, without revision or modification by those funding the research, and protecting the integrity of their work through copyright becomes critically important.

Nonetheless, current Federal regulations leave it to the discretion of Federal contacting officers to decide whether universities should have limited or blanket permission to copyright technical data resulting from Federal research and to require prior approval before the university can establish claim to copyright, publish or release to others computer software first produced in the performance of the contract. This type of provision is used primarily to limit distribution of software by Federal agencies which maintain their own software distribution centers.

The importance of computer software in the transfer of technology is recognized in the Federal Technology Transfer Act of 1986 (P.L. 99-502) which requires (Section 5) that not later than one year following enactment, the Secretary of Commerce shall submit to the President and the Congress a report regarding "any copyright provisions or other type of barriers which tend to restrict or limit the transfer of federally funded computer software to the private sector and to State and local governments;..."

We believe that the type of provision cited above does, in fact, constitute such a barrier.

Federal Rights Inhibit Use of Third Party Data

Every university research project uses a variety of technical data and computer software as tools in the conduct of research.

However, federal agencies have asserted the right to require the delivery with restricted rights of any proprietary software which is used on such research, even when it is provided to the university under standard licenses from commercial vendors.

As applied in practice, the broad scope of these limited and restricted rights has begun to inhibit the acquisition of data from third party sources for use on federally funded university research programs.

Vendors legitimately complain that it is inequitable for the government to obtain for itself and its contractors, the free use of data owned by third parties simply because it was used on federally funded research.

IV. RECOMMENDED FEDERAL POLICY ON RIGHTS IN TECHNICAL DATA AND SOFTWARE

We endorse Section 1(b)(6) of the April 10 Executive Order and recommend that the uniform Federal policy provide that:

Contractor Ownership

The ownership of software and other technical data will remain in the contractor.

Government Rights in Data Required to be Delivered or Prepared

Any rights which the government obtains to technical data or software will be limited to rights in data specifically required to be delivered or prepared under the terms of the work statement, reporting requirements, or specifications of the contract or grant.

We referred earlier to the February 25, 1985, draft of a government-wide data policy statement developed by a subcommittee of the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET). That draft also contained the following statement:

> "Any rights which the government obtains to technical data will be limited to rights in data specifically required to be delivered or prepared under the terms of the work statement, reporting requirements, or specifications of the contract or grant. Broad and sweeping terminology giving the government rights 'in all data first produced or generated in the course of or under this contract' or 'in all data generated under this contract whether or not delivered' should be avoided."

Government Rights for Specific Purposes

The Government will acquire royalty-free license to use such technical data for specific government purposes, but not including the right to license it for commercial purposes or to otherwise permit its use by the government or its contractors in a manner which might inhibit the transfer and commercialization of the technology by the university which created it, except as mutually agreed.

Mr. PRICE. Thank you, very much, Mr. Dummer.

I have been summoned to the Floor for a vote, but we have some time. Why don't we let Mr. Carpenter proceed, and then we will need to recess and come back just as quickly as possible to get into the questioning. Mr. Carpenter, why don't you go ahead.

Mr. CARPENTER. Thank you, very much, Mr. Chairman. That is a marvelous invitation to be brief, and I will be happy to comply.

It is easy to be brief since many of our recommendations and the things we have learned about what make technology transfer—the process permitted to happen—have been stated so well by my predecessor on the program from MIT.

Our convictions are quite similar. It is easy for us to be extremely supportive of the Presidential Executive Order, dated April 10th. We have been embarked on a very ambitious technology transfer effort in Oak Ridge National Laboratory for the past three years. We manage these vast facilities for the Department of Energy.

Among our employees that we have managed since 1984, we count about 1,000 Ph.D.s, and we spend about $600 million of R&D out of total budget. You would expect good technology to come out of this and it does, and would be, we believe, an excellent source of commercial benefit.

Mr. BOEHLERT. Did you say 1,000 Ph.D.s?

Mr. CARPENTER. We believe that is perhaps the largest concentration of any single employer in one location, yes.

We have embarked on this program in response to a DOE request, an enlightened request, in their competition in 1983 and 1984. They said, look, the process isn't working that well—technology transfer, we think the potential is high. Lay some measures on us, some requests for ways that you think you can accelerate it.

We proposed several measures to them and have received and implemented many of those measures, and are delighted to say that the results are very, very encouraging.

We would like to see the liberties that we are operating under extended; they are not complete. We would be delighted to see the complete spirit and objective of the Presidential Executive Order fully implemented.

One's optimism on that occurring is dampened, when you recall that it is very similar in scope—although it is broader this time—to a similar Presidential Executive Order that was issued in 1983, which we find still to this date has not been systematically and thoroughly applied throughout the agencies.

That it should happen in greater measure assumes that the technology has value, inherent merit. I would like to say that based on our experience, and I would just give a couple of examples and then wrap up with some recommendations that we would like to see take place.

A couple of examples of technology that we have successfully licensed in the last two years. We have invented a new super alloy called nickel aluminides, which has many attractive characteristics. One of the characteristics is that it gets stronger as it gets hotter. It is not supposed to that, it is supposed to get weaker, but the curve is going the wrong way.

It makes it very attractive for hot section application. Cummins Engine Company licensed this from us for their use in large displacement diesel engines.

We believe, and they believe, also, that given success, they are going to be able to produce from that Oak Ridge invention several hundred million dollars worth of product that would otherwise have been threatened by the Japanese, who have targeted off-road diesel automotive equipment and heavy machinery as one of their national strategies.

So we believe that if we can free the access of this type of technology for other similar applications, we can—nibble away in meaningful ways our international trade deficit, and particularly the Japanese trade deficit.

We have another application of that same super alloy in electrical resistance heating elements. An older, rather mature company in Michigan had this as its primary product line for many years, heating elements. They have been taking a beating in the international marketplace, frankly, because the materials that are used, nickel and chromium, are available at lower prices from the Russians and their European competitors buy those less expensive materials from the Russians.

Our Michigan firm cannot. They are licensing our nickel aluminides which will permit them to regain a price competitive position, and they have lost some of the European market—they have lost all the European market and some of the American market, and so as far as this firm is concerned, their ability to access our technology may mean even the future of the firm. Again, we are talking several tens of millions of dollars of annual production here that will be done in the United States by American workers, paying American taxes, instead of, on the other side of the balance sheet, in the international trade deficit arena.

We believe this can be multiplied many, many times with additional access. The measures that we would like to see in place include ownership of the intellectual property at the point of origin—very, very important—similar to the recommendations made from our friends at MIT.

We would like to see that include the right to copyright software. Copyright is an imperfect protection device for software, but until the national debate resolves an improved mechanism, we would be delighted to have the ability to use simply that—copyright on software.

We would propose and I have listed in my written testimony—and I am under the presumption, Mr. Chairman, that this will be included in the record.

Mr. BOEHLERT [presiding]. Your full statement will appear in the record.

Mr. CARPENTER. Okay. We have recommended in our written statement some measures that would eliminate some of the problems alluded earlier, related to—is the Government disseminating in the commercial sector in ways that interfere with the software's originator's right, himself, to market in a protected fashion. We have specific recommendations on that.

I think it would be worthwhile to touch upon some of the objections that have been brought up historically, to accelerating technology transfer, and extending the liberties. It is said by some that classified or sensitive work will be compromised.

Well, I believe that this objection overlooks the efficacy of the existing control systems, including three, and that is the classification system, itself; trade and export licensing restrictions; and the secrecy system within the patent system.

To constrain technology transfer because they need it as a fourth system to contain classified or sensitive information seems excessive.

It is said that R&D defense will lose professional talent. They have been operating under publication restrictions for many, many years—for decades, and we have not noticed that we have depleted the skills and ability of our professional work force in defense. So it seems cynical to suggest that it would be harmed by technology transfer activities.

Mr. **Boehlert**. Excuse me, Mr. Carpenter. We are going to have to suspend now. I have about five minutes to get over there and I am not as young as I used to be.

[Recess.]

Mr. **Price** [presiding]. The Committee will be back in order. Adds insult to injury, doesn't it, Mr. Carpenter, to wait all morning and then have to go vote in the middle of your statement. We will ask you to resume.

Mr. **Carpenter**. I understand. Thank you, very much. Actually, I was in the concluding portion of my remarks. Had I hastened, perhaps we could have finished.

In summary, let me outline the conclusions that we have reached based on the experience of our energetic technology transfer effort in Oak Ridge in the last three years.

We believe, number one, for the process to work at an even greater pace on a wider span of technologies, that the technology ownership and transfer responsibility should be placed with the originating organization; point number one.

Two, given ownership of the technology, the originating organization should be freed to pursue the flexible practices of commercial sector licensing.

The third point, our success with our partial liberties granted to us to date indicate two things; our technologies are indeed attractive to the commercial sector, and if available to the commercial sector under attractive terms, they are going to adopt them.

This means that we have essentially obtained R&D for nothing.

We believe if we had the full liberties proscribed in the President's Executive Order, we could increase several-fold the commercial use of the Government technologies that we are involved within Oak Ridge. That will complete my verbal remarks. Thank you, very much.

[The prepared statement of Mr. Carpenter follows:]

U. S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HEARINGS ON FACILITATING ACCESS TO GOVERNMENT TECHNOLOGY

APRIL 30, 1987

STATEMENT OF
WILLIAM W. CARPENTER
VICE PRESIDENT, TECHNOLOGY APPLICATIONS
MARTIN MARIETTA ENERGY SYSTEMS, INC.
OAK RIDGE, TENNESSEE

OPENING STATEMENT

I believe that the Presidential Executive Order of April 10, 1987, and the measures outlined therein, strike at the heart of a significant issue for this Nation: how to fully integrate our federal laboratories into the U.S. economy through technology transfer. My testimony is directed toward explaining our attempt to implement an aggressive technology transfer program at the facilities Martin Marietta Corporation manages for the Department of Energy (DOE) in Oak Ridge, Tennessee, Paducah, Kentucky, and Portsmouth, Ohio. Over the past three years, Martin Marietta Energy Systems, Inc. in cooperation with the Department of Energy has had the opportunity to actually test the utility and benefit of allowing the management contractor of a federal facility to directly effect the transfer of certain, selected technologies. Our experience confirms and reinforces our prior belief that, if federal agencies fully and literally implement this new Executive Order, the beneficial influence of technologies transferred from government facilities on our international balance of trade would be indeed great. It should be noted, however, that a similar Order of February 12, 1983 has not, in fact, been uniformly instituted among government agencies. With this view in mind, it would be comforting to see positive and absolute closure by all affected agencies on the objectives pronounced in the recent Executive Order. Such closure can and should be achieved through procedural means already available. If this is not possible, however, then additional legislation may be required. We ask that we now be given, by whichever means, the freedom and flexibility to expand our program in ways consistent with the President's Executive Order and legislative initiatives taken since 1980.

Let me explain.

TECHNOLOGY TRANSFER FROM GOVERNMENT FACILITIES IS IMPORTANT IN ENSURING U.S. GLOBAL ECONOMIC COMPETITIVENESS

At the same time the United States is enjoying a period of relative economic stability, our Nation faces a serious challenge to its future competitiveness. Our competitive preeminence in world commerce has eroded over the past decade. We are being challenged in the trading arena by our European trading partners and emerging nations of industrial significance in Asia and Latin America. Sustaining our competitiveness over the long term is all important in maintaining our standard of living, advancing our foreign policy aims, and our national security.

Fueled by R&D, technological innovation is vital to our future because it is the key to productivity advances. Over the past 50 years, it has been the most important generator of productivity growth, far surpassing the contributions of capital, labor, or economies of scale. The United States must advance and apply technology toward the goals of enhancing our economic vitality, maintaining our national strength, and improving our general well-being. We must use it to improve our industrial productivity and competitiveness. Successfully directed to this purpose, new technology can provide us with our greatest comparative advantage and ensure our industrial leadership in an increasingly competitive world.

An analysis by the President's Commission on Industrial Competitiveness (1985) recently pointed out that our nation investment in total R&D (as a percentage of GNP) is on a level commensurate with other nations. They also pointed out, however, that the portion funded by the federal government is about 50% and, of this amount, more than 50% is directed toward defense-related purposes. Such countries as West Germany and Japan, on the other hand, devote the vast majority of their government-supported R&D toward civilian purposes. Thus, the extent to which we approach effective R&D parity with our trading partners depends heavily on our ability to derive commercial benefits from federally-funded R&D programs.

In addition, over one-third of the R&D supported by the government is conducted in the more than 700 federal laboratories which employ about one-sixth of our nation's scientists and engineers. To optimize application of U.S. R&D, industry must more fully utilize the research results and research capabilities of federal laboratories. One way to achieve this goal is through increased R&D cooperation between federal laboratories and specific industries. Another way is to create a framework of incentives for private sector firms to invest in the commercial development of federally-developed technologies, and to make government-developed technologies readily available to the commercial sector under terms that are attractive to them. Even with the supportive legislation that has been passed, such is not yet the case.

Congress recognized, correctly in my view, that government-owned patents are underutilized. In an effort to foster increased commercial exploitation of government-developed technology, there has been a recent, gradual shift toward a policy that permits ownership to stay with the contracting firm, subject to "march-in" rights if the inventions are not in fact used.

The importance of the technologies being developed at federal facilities should not be underestimated. Let me give you just two examples of technologies which illustrate my point. Oak Ridge National Laboratory (ORNL) has developed a class of new materials, called nickel aluminides that has the unique property of getting stronger as they get hotter. Already Cummins Engine Company has taken a license and is developing the material for its next generation of heavy duty diesel engines - an area the Japanese have targeted for increased market penetration. What is perhaps more interesting is that the leading U.S. manufacturer of wire for heating elements has discovered, by working with ORNL, that this same material also has unique properties for their application. They are optimistic that this technology may be the key to regaining market share in the U.S. which has been eroded by the Europeans. Perhaps more importantly, the technology may give them a chance to be effective in international markets where they currently can not be competitive due to the fact that foreign firms enjoy much lower costs because they are able to use raw materials supplied by the Soviet Union.

ORNL has also been a leader in the development of advanced ceramic materials. One such, a silicon carbide whisker-reinforced composite, has been demonstrated to be superior to other materials as a cutting tool in certain applications. I do not need to remind you of the gloomy statistics for the U.S. machine tool industry. This material has already established a sizable niche in this depressed market with double digit growth projections on the horizon. This material is looked upon as being one of the significant new developments in this industry with virtually every manufacturer of cutting tool inserts lining up to take a license. As I will discuss later, this development is significant also in that we are attempting in our licensing program to provide a secure U.S. market, free of foreign-based competition.

Even though, in each of these cases, the U.S.-based suppliers has been faring badly in the international marketplace, I do not believe they would have adapted the government-developed technology to their commercial use under the historically available, direct government licensing program. Through our direct licensing of just those technologies illustrated, however, we see the prospect of a several hundred million dollar increase in U.S. production with a corresponding decrease in our international trade deficit.

ALTHOUGH THE POTENTIAL BENEFITS OF TECHNOLOGY TRANSFER APPEAR GREAT, A NUMBER OF CONCERNS HAVE BEEN RAISED

These changes have not been accomplished without much policy debate, however. A number of concerns have been raised regarding the granting of greater technology transfer liberties to the organizations generating the technology, especially where the organization is a DOE Management and Operations (M&O) contractor. I would like to discuss these concerns.

Classified or Sensitive Work Will Be Compromised

The fear is that, left unfettered, federal facilities such as Oak Ridge will begin to engage in activities that will compromise secret developments important to the defense of our nation. I believe these critics overlook the efficacy of existing control systems such as classification regulations, export control procedures, and the current system of secrecy orders on patent applications. Using the patent system for even further protection would appear unnecessarily redundant with these primary control systems.

Defense R&D Will Lose Professional Talent

Another fear is that we would begin to discourage professionals from working on important, but classified, defense-related missions because they would not have the opportunity for recognition and benefit like their civilian counterparts. I would only remind you that we have been operating under publication restrictions in these very same fields for years and we have not seen a significant decrease in the quality of the scientists and engineers attracted to this work. It seems cynical to suggest that these same people would somehow change their interests or allegiances simply because of the rather remote prospect of being financially rewarded for the commercial use of their invention. Further, these individuals could still participate in the often applicable cases of the unclassified inventions which derive from defense R&D.

National Laboratory Missions Will Become Skewed

Another objection which has been raised, with particular reference to the National Laboratories, is that allowing laboratory personnel to work too closely with industry or participate in the financial returns from licensing their inventions will somehow distort their historical and valuable mission of more basic R&D. I believe that this opinion does not truly reflect the basic psychology that drives scientists. These individuals are driven by a fundamental curiosity about physical phenomena. They are not particularly interested in developing commercial products or understanding what the market potential is for some device based on their invention. If they were they would have probably gone to work in an industrial laboratory. It is interesting to note that many of our scientists have left industrial labs to come to work at ORNL.

The benefits of the personnel interactions between laboratory and industry is well illustrated by the generally acknowledged conclusion that the "Silicon Valley" enhanced, rather than detracted from, the excellence of the scientific talents and capabilities at Stanford University. The same is true of the influence of Boston's Route 128 development on MIT.

Our technical people do want to see their developments used. We have lost a number of our best people because they became frustrated with the lack of use of their inventions. I had a chance to talk with one of our scientists who recently rejoined us after spending a number of years working in industry. He told me that he left ORNL after 20 years of developing technology that was never put to use. He went to industry so he could see his work put into practice. He came back to ORNL, not because he was dissatisfied with his industrial experience, but because the renewed emphasis on technology transfer gave him the opportunity to work on the technologies that interested him with a prospect of seeing them carried forward by others into the marketplace.

Scientists and Engineers Will Be Less Willing to Communicate their Results

-- The patenting interests of the U.S. government have, heretofore, prevented open technology disclosure prior to the event of patent application. It is difficult to see how this circumstance would change, for the worse, by permitting greater freedoms to transfer the technology.

It is interesting to note that since Martin Marietta's implementation of added measures to transfer technology in 1984, technical publications have actually increased, reversing a previous five year decline. In spite of the fact that budgets have not grown, this number continues to increase each year.

Operating Contractors Will Receive a "Windfall" Advantage at the Expense of Other Contractors and the Taxpayer

This point merits careful discussion. Presumably it was this suspicion that led the Congress to omit for-profit Government-Owned, Contractor-Operators (GOCO) from the liberties extended to small business and non-profit GOCOs and Government-Owned, Government-Operated (GOGO) laboratories in P.L. 98-620 and P.L. 99-502.

Like any other performing contractor, the for-profit contractor (particularly the GOCOs) should be given technology ownership for commercial needs because the originating firm knows more about the technology than any other organization. Thus, they are better positioned and perhaps more motivated to adapt it to other uses.

Performing contractors have, for decades, had the contractual right to individually petition for all non-governmental rights for inventions which they wished to utilize. These petitions are usually, if not routinely, approved. There is nothing new, then, in the conclusion that the originating organization is the "best bet" for technology transfer authorities.

To afford the originating organization, including for-profit GOCOs, advanced assurance that they can have the right on a timely and automatic basis motivates them to act on a wider range of technologies including a range of technologies that otherwise would not have been used by them or, in all probability, by anyone else.

It should, further, be noted that in the case of Martin Marietta's proposed program, we propose technology transfer methods that are essentially non-profit to our firm. Although we would support technology ownership for all originating organizations with or without the non-profit provisions of our proposal (simply because more commercial usage will result) there is certainly no "windfall" potential in the program we have proposed.

MARTIN MARIETTA ENERGY SYSTEMS SOUGHT TO ESTABLISH AN AGGRESSIVE TECHNOLOGY TRANSFER PROGRAM IN OAK RIDGE

We support all of the recent initiatives by the federal government to enhance the transfer of federal technology to the private sector. However, to agree upon the objective is much easier than succeeding with the process.

In the 1983 competition for the Oak Ridge facilities management contract, DOE asked the bidders to propose resourceful measures to accelerate the process of technology transfer. Martin Marietta proposed four primary measures:

1. Broaden the scope of existing technology transfer functions to include all operating facilities under the management contract and establish a central function, headed at the executive level, that would not just permit but would cause increased levels of technology transfer.
2. Put the title to all intellectual property of commercial value in the contractor's name under the terms of an advanced blanket waiver.
3. Develop and implement an array of financial rewards and recognition for the inventors.
4. Create supporting mechanisms to cause and encourage new business formation based on Oak Ridge-developed technologies.

Of the measures requested, all have been accomplished and are in place except the second.

We originally proposed that we receive an advanced blanket waiver of patent rights from DOE so that we might be in a position to offer the necessary patent protection to commercial clients interested in further developing products based on our technologies. None of the income generated from the licensing of patent rights would accrue to Martin Marietta. These monies would be used exclusively to advance DOE's stated objectives regarding technology transfer. First, this fund will be used to pay inventors a share of the royalty income. Second, royalties would be used to cover expenses incidental to patenting and licensing activities. Finally, the remainder of the fund will be rededicated to fund selected technology maturation initiatives directed toward bringing new developments to a state of greater attractiveness to commercial clients.

Unable to obtain the advanced patent waiver provisions of the contract, we agreed to delay final resolution of this issue until after the DOE management contract was signed on April 1, 1984. Martin Marietta submitted a petition for an advanced patent waiver on April 30, 1984. DOE chose, instead, to consider a class waiver for all GOCOs including one to cover our contract. To date, those class waivers have not been granted notwithstanding the pronouncement by then-Secretary Hodel on February 5, 1985 of the class waiver approach as DOE policy with instructions for implementation. Thus, we still lack what we consider to be the most important technology transfer tool - the timely ability to control the rights to patentable technologies invented by the Martin Marietta Energy Systems employees.

IN SPITE OF CONSTRAINTS, WE HAVE DEMONSTRATED THE POSITIVE IMPACT OF OUR APPROACH

Without some type of advanced waiver, Martin Marietta Energy Systems has available only the procedure for petitioning, on a case-by-case basis, for a waiver of patent rights on each invention after it is made. This is a cumbersome and time-consuming procedure that, historically, has not yielded a satisfactory or timely result. In 1986, we submitted 155 invention disclosures to DOE. Of this number, about 30 are thought to have commercial potential.

We have already gone through this laborious process on 45 cases. Table 1 lists a chronology for the technologies which have been waived to Martin Marietta Energy Systems. It is clear from Table 1 that the process of obtaining a patent waiver can be a long process. We should add that in the last 5 months DOE has granted 21 of 22 individual waiver requests that we began identifying in September of 1985 as having high priority for near-term transfers.

Although this responsiveness represents a serious attempt by DOE to effectuate the transfer process, it also illustrates the additional advantages of routine, automatic, and instant ownership by the originator.

You will also observe from this Table that we often sign licenses with industrial firms within days or a few weeks of the waiver grant from DOE. This means we are often placed in the tenuous position of negotiating tentative licenses with clients before we have any assurance that we will receive rights to the intellectual property. This is clearly not an acceptable long-term position.

The value of intellectual property is often perishable with time. Inventions developed at the Oak Ridge-Paducah facilities tend to be on the leading edge of technology and are, thus, highly susceptible to rapid change. The ability to make timely decisions is important in order to respond quickly to industrial requests for licenses. Delays in assigning patents can often result in missed opportunities to successfully transfer the technology either because alternative technologies are developed, the market opportunity to capitalize on the project passes, or the company grows frustrated and loses interest in the technology.

In spite of this major constraint, we have proceeded, with the encouragement and cooperation of the DOE Oak Ridge Operations Office, to vigorously institute a program of transferring technologies to private sector firms. Table 2 lists some of the significant accomplishments of this effort since Martin Marietta Energy Systems assumed the management contract in Oak Ridge.

IMPORTANT NATIONAL GOALS NEED NOT BE SACRIFICED IN THE PROCESS

In addition to moving more technologies out of the government facilities and into commercial practice, we believe our approach preserves certain, traditionally important national objectives.

First, the government's rights to the technology are protected. Every license preserves for the government a royalty-free, paid-up, non-exclusive license to the technology. What this translates into is that any firm has the right to use the technology for government purposes without a license from Martin Marietta Energy Systems. In addition, no royalties are assessed to commercial product licensees on sales of the technology for government use. In fact, we require, in our license agreements, proof that the firm actually reduced the price charged for sales for government purposes by at least the amount of the royalty due on a commercial sale.

Second, our licensing policy requires an active plan for commercial exploitation of the technology by the licensees. This plan typically includes a plan with technical goals and milestones for developing a commercial product, planned levels of investment for the technology, and a timeframe for introducing the product onto the market. This plan is then adapted to provide contractual "strings" such that, if the licensee does not aggressively pursue the technology, the license may be terminated by Energy Systems freeing us to pursue other clients.

Third, our licensing policy requires, at a minimum, that products sold on the U.S. market be substantially produced in the U.S. The significance of this point to the United States economy is tremendous. It enables all firms wishing to pursue U.S. markets to compete on a level playing field with similar costs of capital, labor, and the like. U.S. workers make up the primary labor force manufacturing the products based on the technology. Finally, U.S.

taxpayers, the original investors, are the big winners through the generation of additional jobs and tax revenues from increased domestic economic activity.

WE REMAIN CONVINCED THAT WE CAN FURTHER ACCELERATE THE TRANSFER OF TECHNOLOGIES TO BENEFIT THE U.S. ECONOMY

Our experience confirms our belief that, should we finally be granted the authority which we seek, to manage our intellectual property portfolio, we can accelerate the rate of successful transfers of technologies from the Martin Marietta Energy Systems facilities to industry. We firmly believe that all intellectual property (except that related to national security interests) that has commercial potential should be owned by the originating organization. Such ownership would, of course, be subject to the government's paid-up, royalty-free, non-exclusive license. Our conviction on this matter is based on a number of considerations.

First, unless the contractor gets substantial rights to intellectual property, there is little incentive for him to establish technology transfer programs that may lead to commercialization of the research. Succeeding royalties can provide the means to reward the inventors, to cover the cost of producing sample materials or prototype instruments required to demonstrate the technology to potential licensees, and the other initiatives necessary to mature commercial interest in the technology; all at no cost to the government or the performing contractor.

Second, commercialization of technologies developed at government laboratories is best accomplished by the originating organization, usually by licensing the technology to a third party. The originating organization is better positioned to assess the technology's stage of development and commercial potential for the various applications. Laboratory inventors are often in contact with their counterparts in commercial firms who are following the developments in the technology area. These interactions are a fruitful source of information on potential commercial applications for the technology. In the case of the Martin Marietta program, our licensing policy provides incentives to inventors to increase these contacts with companies wishing to commercialize the technology. These interactions, in turn, carried on after a license agreement has been formalized, provide a source of technical support for the licensee. In addition, these same interactions should increase not only the number of companies interested in pursuing government ideas, but also the number of patents on government-sponsored R&D which become the basis for commercial products.

Third, we are able to pursue our licensing program in accordance with accepted commercial practices. Our approach includes negotiation flexibility which recognizes the unique circumstances of each technology, client, and market. This also includes offering exclusive licenses if that is required in order to provide the necessary incentive for a firm to invest in commercializing the technology. We also include provisions for policing the patent in order to provide a measure of protection for the licensees' investment. In addition, by combining the patenting actions with commercial licensing activities, the types of intellectual property protection needed in the commercial sector become better understood. The probable end-result is improved patent protection for commercial needs.

TO TRULY BE EFFECTIVE, OTHER AUTHORITIES ARE REQUIRED

Technology Ownership by the Originating Organization

Direct management of our technology portfolio appears to be a prerequisite to an effective and responsive technology transfer program for the reasons previously discussed. How can this be accomplished?

It appears to us that our near-term requirements could be satisfactorily met through DOE's granting either the advanced waiver which we have requested or a properly constructed class waiver. Although industry has not yet had the opportunity to comment on the proposed DOE class waiver, based on DOE's description to us of the provisions of such a waiver, it would seem to accomplish much of ours needs. Therefore, as a first priority, we would request the expeditious implementation of the class waiver now in process.

If the final class waiver stops substantially short of meeting the full objectives of the recent Executive Order, then we would urge enabling legislation for the basis for more complete compliance. If, in the worst case, timely issuance of the class waiver is not possible, for whatever reason, enabling legislation should be enacted as a separate alternative.

Freedom to Use Royalty Revenues as Individual and Institutional Financial Reward

In order to actively engage the originating organization, as well as our scientists and engineers, in the process, we need to provide the incentives alluded to above. We must be permitted to reward the inventors for their participation in the creation and transfer of a commercially valuable technology. We need to be able to provide the organization with the funds (not from the taxpayer, but from royalty revenues) to cover the costs of promoting the technology and bringing them to the point where they are commercially most attractive. To date, we have not been authorized to expend any of the royalty funds received. We have proceeded, assuring our employees that we believe we will be authorized to implement our procedures for financial rewards. As you might expect, in time, such goodwill can be easily exhausted.

Direct Authority to Enter into Collaborative Agreements with Industrial Firms

In many cases, we have been able to attract industrial firms to an existing laboratory technology. The invention often requires additional development, however, before it can be used, and the organization where the technology originated is usually the best place to do the follow-on work. The tremendous increase in the number of requests for just this sort of relationship is evidence of industry's acknowledgment of the benefits of such arrangements.

Because such collaboration between a laboratory and industrial organizations often leads to future inventions, all parties must be clear on who will have what rights to future inventions when the work begins. For this reason the laboratory must be able to directly negotiate with the industrial firm and assign or issue patent licenses on inventions arising out of both the government-sponsored R&D and the resulting collaboration. We recognize that such agreements must be consistent with the missions of the agency and laboratory. The primary purpose of the arrangement, however, is to leverage the government expenditures with simultaneous commercial sector R&D.

Permission to Copyright Software

We also ask that the definition of intellectual property available to us for transfer be expanded to include copyrights on computer software. We have discovered that the facilities in Oak Ridge are a rich repository of such valuable intellectual property. We are not, however, getting the maximum use from this technology. Although the DOE has made provisions for the dissemination of computer software through its National Energy Software Center (NESC), the approach appears to be inadequate based on experience to date.

NESC suffers from many of the same problems one would expect when the agency charged with transfer is remote, or even different, from the originating organization. Such a central organization can provide only limited technical support, and it does not have the incentive or means of marketing the software to the appropriate end-users. Experience has shown that the Center is inadequately used by U.S. industry. What is more alarming, however, is that foreign commercial firms utilize this software more frequently than the U.S. commercial firms!

We propose that NESC's mission be restricted to the dissemination of the software to U.S. government users only except for limited international distribution in cases where an appropriate international agreement on the technology exists. In these latter cases, however, distribution and use would be restricted to government purposes only, specifically precluding commercial use. We further propose that the originating organization be granted the authority to copyright and be allowed to license it to commercial vendors. As a condition of the copyright authorization, we propose that the licensor agree to establish a minimum of one commercial sector source for qualified technical support available not only to commercial customers but also to government users. We believe such an approach will greatly enhance the use of government-developed software in both government activities and commercial firms.

Fortunately, local contracting authority already exists which permits the granting of copyright requests on a case-by-case basis. We, with the encouragement and support of the DOE Oak Ridge Operations Office and the DOE Office of Scientific and Technical Information, launched an experimental program consistent with the principles outlined above. During 1985 and early 1986, we requested and were granted copyright authority in five cases (see Table 3). In 4 out of the 5 cases we were able to generate revenue bearing licenses with commercial clients. These royalty revenues were handled identically to those from patent licenses. Again, we believe these instances of commercialization by U.S. firms would not have occurred under the historical "free to all who request" practice.

DOE has, however, stopped granting our requests to copyright. We request that copyright requests again be granted.

With the above described additional authorities in place, we are firmly convinced that we, and others in or general circumstance, can greatly expand and accelerate the pace of technologies being transferred from the government facilities.

CONCLUSIONS

I. Technology ownership and transfer responsibilities should be placed with the originating organization.

II. Given ownership of the technology, the originating organization should be freed to pursue the flexible practices of the commercial sector in the development of commercial use, including licensing.

III. Our success with the partial liberties granted us indicate two things: (1) Our technologies are attractive to commercial firms under the right terms and conditions; and (2) If we had the full liberties proscribed in the President's Executive Order, we could increase, significantly commercial use of government-developed technology.

Table 1. PATENT WAIVER PETITIONS GRANTED AND LICENSED

April 28, 1987

INVENTION DISCLOSURE	SUBJECT	PETITIONED FOR WAIVER	WAIVER GRANTED	TECHNOLOGY LICENSED
4207-Y/S-58,019	Carbon Free Zirconium	11/26/84	12/03/86	
4338-X/S-59,268	Nickel Aluminides (Super Alloy)	9/25/84	06/21/85	Licensed 09/06/85
4385-X/S-60,520	Servomanipulator	11/26/84	12/03/86	
4392-K/S-60,513	Remote Tong Tool Catch for Servomanipulator	11/26/84	12/03/86	
4406-X/S-60,528	Silicon Carbide Whisker Reinforced Ceramic Composite	03/22/85	06/09/86	Licensed 06/27/86
4412-X/S-61,109	Nickel Aluminides (Super Alloy)	09/25/84	06/21/85	Licensed 09/06/85
4449-X/S-61,155	Improved Osmium-191/Iridium-191m Radionuclide Generator System	12/26/85	12/03/86	
4504-X/S-61,810	Rotor and Disc System for Processing of Whole Blood Samples	12/27/85	12/03/86	
4507-X/S-61,896	Tong Actuator Servomanipulator	11/26/84	12/03/86	

TABLE 2. ACHIEVEMENTS OF ORNL TECHNOLOGY TRANSFER PROGRAM

Licensing

- 12 royalty-bearing licenses have been executed between October 1985 - March 1987 with up-front payments totaling over $200,000.
    - Negotiations on 15 additional licenses are currently in progress.
    - Licensed technologies include whisker-reinforced ceramics, nickel aluminides, fiberoptic luminoscope, and self-aligning grip system for tensile testing of ceramics.
    - Licensed firms range in size from less than 10 employees to more than 10,000 employees.
- Contingent commitments for developmental R&D for exclusive licenses exceeds $10 million.
- Additional Notes:
    1. Over 40 other technologies were transferred to over 200 organizations through non-licensing approaches.
    2. Over 50 workshops were held to make industry aware of various technologies including a Technology Open House attended by representatives of about 150 firms.

Collaborative R&D and R&D Performed on Contract for Others

- Cooperated with Johnson & Johnson and Spire to develop a technique for ion-plantation on medical prostheses such as hip and knee joints.
    - About 2,000 devices have been produced to date.
    - About 35 companies have used the Surface Modification and Characterization (SMAC) User Facility over the past three years.
    - A number of firms have approached the operators of the SMAC user facility about the forming an industrial consortium to investigate advanced processing technologies for electronic materials.
- Formed the Measurement and Controls Development and Engineering Center in cooperation with the University of Tennessee with about 9 corporate sponsors.
- Completed a $1 million contract for the Cabot Corporation which resulted in the development of a new class of ductile nickel sillicide alloys (4 patent disclosures) and a gas-sensing chip (2 patent disclosures) which also won an IR 100 award in 1986.
- Over the past three years, about 75 R&D contracts were performed for commercial firms.

TABLE 2 (con't). ACHIEVEMENTS OF ORNL TECHNOLOGY TRANSFER PROGRAM

- Worked with Babcock and Wilcox to combine our chemical vapor infiltration (CVI) technology with their ability to weave fiber preforms to create ceramic composites.
    - Six other firms have requested permission to collaborate on other applications of the CVI technology.
- Assisted a group of ceramics companies, including Dow, Sohio, GTE, Norton, Allied-Signal, and Boeing, in forming an industrial consortium called the Ceramics Advanced Manufacturing Development and Manufacturing Center.
- Working with A. E. Staley's Loudon County, Tennessee plant to test the technical feasibility of adopting an advanced bioreactor and biocatalyst technology for continuous processing in the production of ethanol and high fructose corn syrup.

New Business Development

- Martin Marietta Corporation formed the Tennessee Innovation Center (TIC) to assist in the development of entrepreneurial firms.
    - The TIC has formed 9 companies with 4 based on technologies originating from ORNL. Sales by these 9 firms is expected to exceed $70 million by 1990.
- Assisted in the start-up of six firms based on spin-offs of technologies and employees from ORNL.
- Assisted in the development of two joint venture firms to commercially develop and market ORNL technologies.

Research Exchanges

- Initiated a program to bring industrial researchers into ORNL for temporary assignments to participate in collaborative projects designed to transfer the technology to the visitors' firm.
    - 10 firms and about 15 researchers have participated to date.
    - The number of industrial visitors at ORNL has increased by over 200% in the last 2 years.

Awards

- Won 13 IR 100 awards over the last three years for the most commercially promising inventions.
- Won 2 Special Awards for Excellence in Technology Transfer from the Federal Laboratory Consortium.

Table 3. COPYRIGHT AUTHORIZATION REQUESTS

April 28, 1987

ESCR NO.	REQUEST SUBMITTED	SUBJECT	GRANTED	LICENSED
3-X	03/07/85	Luminoscope II Circuit Drawing	06/25/85	Licensed 12/19/85
5-X	03/25/85	Automatic Coordinate Measuring Program	12/13/85	
8-X	05/17/85	Quality Control Program for Analytical Chemistry Laboratories	12/13/85	Licensed 10/31/86
11-X	10/08/85	ANFLOW (Anaerobic Sewage Treatment)	02/04/86	Licensed 02/06/86
14-X	02/12/86	Radioactive Materials Shipping Package Design	03/19/86	Licensed 05/07/86

INVENTION DISCLOSURE	SUBJECT	PETITIONED FOR WAIVER	WAIVER GRANTED	TECHNOLOGY LICENSED
4508-X/S-61,874	Master Controller for Servomanipulator	11/26/84	12/03/86	
4531-X/S-61,893	High Temp Alloy	10/18/84	06/21/85	Licensed 09/06/85
24-X/S-62,550	Method for Producing Biocatalyst Beads	05/16/86	01/20/87	
43-X/S-62,596	Method for Sintering Whisker-Reinforced Alumina Ceramics	12/26/85	06/09/86	Licensed 06/27/86
52-X/S-63,523	Silicon Carbide Whisker-Zirconia Reinforced Mullite Ceramics	12/26/85	06/09/86	Licensed 06/27/86
59-X/S-63,520	Self-Aligning Hydraulic Piston Assembly for Tensile Testing Apparatus	05/16/86	09/23/86	Licensed 09/24/86
99-Y/S-63,640	Multi-Layered Composite of Zr0 Bonded Zr0 and Metal 0 Fibers	05/16/86	12/03/86	
108-Y/63,654	Fiber Optic Coupling	05/16/86	12/03/86	
126-X/S-63,665	Biocatalyst Beads w/ Incorporated Absorbent	05/16/86	01/20/87	
127-X/S-63,668	Production of Anaerobic Biocatalyst Beads	05/26/86	01/20/87	

INVENTION DISCLOSURE	SUBJECT	PETITIONED FOR WAIVER	WAIVER GRANTED	TECHNOLOGY LICENSED
142-X/S-63,682	Rotor and Disk System for Processing Whole Blood	05/16/86	12/03/86	
82-X/S-63,618	Lead Phosphate Glass Composition for Optical Components	05/16/86	01/22/87	

Mr. PRICE. Thank you. Both of you have advocated giving the originating institution title to copyrighted and patented products developed under Federal contract at the earliest possible time. I think that one question that might arise in this connection is whether the emphasis on commercialization, and/or licensing by the originating institution, whether that might adversely affect the selection of contractors by accenting marketing over innovation, giving undue weight to marketing and commercial factors.

I wonder if you could comment.

Mr. CARPENTER. We are recommending that the originating organization have the rights simply because they are more familiar with the technology, its stage of maturity and development. They, as an organization, may not themselves commercially exploit. They may, in turn, license and they can engage even that process with greater ability than someone who is less familiar with the technology.

In that regard, I don't believe it would either distort the mission of existing organizations, such as Oak Ridge National Laboratory that we manage, nor in any significant way influence the range of people that might bid to succeed Martin Marietta in the management of that. I can't see that being a significant factor, frankly.

Mr. PRICE. Mr. Dummer?

Mr. DUMMER. I don't see that myself as a significant factor, in terms of university research, and the selection of contractors by Federal agencies which support it. I think that university generated technology is largely the serendipitous result of ongoing fundamental research programs which have not been directly slanted towards the potential for commercializing technology. I think that most of the research that is supported at MIT under contract, (and this is somewhat analogous to peer reviewed grants from such agencies as NSF and NIH) results from research proposals submitted in response to broad agency announcements from agencies such as DOE, ONR, the Air Force Office of Scientific Research, the Army Research Office, and the Office of Energy Research. There should be no adverse effects as long as Federal agencies recognize that the best technology is often the serendipitous result of good basic research. John Preston might also wish to address the question of whether the ability of a university to commercialize technology should influence its selection as a contractor or the role of faculty directed research.

Mr. PRESTON. Yes, I would like to make a few comments on that. MIT, first of all, doesn't have any marketing arm, except for a technology transfer marketing arm. So for the contracts awarded to MIT, you could make the argument that since we don't have any effective marketing arm, MIT should not be a contractor.

However, if you look at the success of MIT in actually transferring the technology to industry, the fact that there has been over 1,000 spin-off companies from MIT, the fact that we are licensing two technologies per week right now to industry, I think you will find that there is indeed a good coupling between universities like MIT, Stanford and industry, and so I think that your question is a very difficult one to answer because the marketing arms of the contracting organization may not be the right thing to look at. You may want to look at what is below the surface. What is the relationship between the university and industry and their effectiveness in taking this technology out and getting something commercial made of it.

Mr. PRICE. I wonder about the difference between academic and industry contractors; ought that difference be reflected in the way the Federal Government allocates ownership to intellectual property?

Mr. DUMMER. In looking at some of the regulations which have been applied to the determination of rights of the universities, I think the universities have felt that they have been included in a set of regulations very often that stem from statutes which have been based primarily on competitive procurement situations.

The need for competitive procurement for military systems and hardware appropriate to defense contractors and the lumping of the universities under procurement regulations where hardware systems and reprocurement are a predominant factor has distorted the manner in which Federal agencies determine university rights in intellectual property.

Now, I think that the differentiation of basic and applied research being done by universities and Federal laboratories should be clear, and if there are problems generated with respect to defense contractors, competitive procurement systems and hardware, they should be treated separately. Our concern at the moment is that they tend to have been merged and this further complicates the determination of rights on the university side.

So I do think there are different principles for the basic and applied research in the university/federal lab setting, as opposed to the hardware oriented defense contractors.

Mr. CARPENTER. Apparently there is perceived to be a difference and, otherwise for-profit GOCOs would have been included in either of the two preceding significant pieces of legislation. I think that there is a continuing suspicion that a for-profit contractor will receive a windfall advantage or a competitive advantage, denying other contractors—that there is a potential for a corporate rip-off involved.

Certainly in the program we have recommended in Oak Ridge, we operate as a non-profit because any royalty revenues that derive do not become corporate profits. We put them in a set-aside, escrow fund, if you will, to use to pay our inventors' participation and use the remainder for administrative licensing program costs, reimbursement, and to mature other technologies.

So no windfall charge related to the program that we have recommended, but I believe that I would recommend and, in fact, do in my paper, recommend that the right to stay with the originating organization, whether he has recommended a non-profit program or a profit program, because, after all, we are interested in commercial exploitation here. We are interested in U.S. production, getting a commercial benefit. He is best poised to do that.

Mr. PRICE. Let's turn specifically to the Executive Order. Are there any changes that either of you would recommend in that April 10th Executive Order? Do you view the policy recommendations in your testimony simply as a plea that the Order be fully implemented, or are you suggesting further refinements?

Mr. **Dummer.** I endorse the thrust of the Executive Order, but with respect to Section 1(b)(6) and a uniform policy with respect to technical data, I think that the implementation of that in a manner that is analogous to Pub. L. 96–517 is going to take a period of development to determine what license rights, and so forth, would be comparable to the rights that now exist under Pub. L. 96–517.

I assume OFPP will have to explore various possibilities and various proposals for specific language and licensing and so forth. The process by which the Federal Acquisition Regulations have recently been revised and a new set of data regulations proposed has taken a seemingly interminable number of years, and they still do not respond to major university concerns.

I think it will take some gestation period, and those of us who are affected by it will want to make recommendations for specific language. The regulations are quite important.

After Public Law 96–517 was passed, there was also a long and difficult period before regulations which seemed reasonable to implement the statute were worked out between universities and nonprofits, and Federal agency patent personnel.

Mr. **Price.** Before turning to Mr. Carpenter, let me just follow up on that a little bit. Are you suggesting a course—that agencies have been resistant, reluctant to apply the philosophy, the policies on which that Executive Order is based. Could you elaborate on that a little bit as to which agencies perhaps have been particularly reluctant to act and whether that has been equally true at all the labs?

Mr. **Dummer.** No, I believe that the agencies that have been most reluctant are those which believe they have an overriding responsibility for disseminating the technology that is generated by their contractors, and that also happens to be the policy that is stated in the civilian agency data regulations—the statement of purpose in FAQ 27.4 embraces that view. The two agencies in particular that reflect that policy are the Department of Energy, particularly in the operation of its National Energy Software Center, and also the National Aeronautics and Space Administration in the operation of what I believe is called its Cosmic Program, which, as I recall, is located at the University of Georgia. Both agencies, because of their desire to distribute software through those centers, retain the right to require the delivery, with broad Government rights, of software generated under university contracts. The crosscurrents that are generated—the conflicts in terms of who has the center of gravity in the commercialization—inhibits university licensing of commercial organizations.

In fact, the use of one of MIT's major software programs for distribution at the National Energy Software Center rather seriously affected the ability of our licensee to commercialize the software because the DOE distribution included all DOE contractors, who then hired software assistance from a nonlicensed firm to help them maintain it. So I think it is primarily DOE and NASA that I would refer to.

Mr. **Price.** Mr. Carpenter, do you want to comment on the specifics of the Executive Order?

Mr. **Carpenter.** I note no deficiencies in the Executive Order. I think the concern would be in our ability to actually achieve full implementation of the spirit. In our case, we happen to operating under the aegis and under contract of the Department of Energy, and so we could say—well, the intent of that Executive Order could perhaps be met by aggressive implementation action within their already-existing authority.

Will that occur? Is it possible for them to move ahead with class waivers of patents, and if so, we would think that the substantial intent of that Executive Order could be met without the need for new legislation.

If for some reason or another, it can't, or it doesn't happen, then we would like to see positive implementation by other means, perhaps even additional legislation.

Mr. **Price**. Mr. Dummer, we earlier had a witness from the Department of Energy, and we asked him to submit for the record an explicit response to your recommendations. It seems fair enough to ask you, therefore, whether you were particularly encouraged or discouraged by that DOE testimony; any specific comments you would want to make now, and of course, we would be willing to receive anything you would want to submit later for the record.

Mr. **Dummer**. I think the only comment I would make is that I noticed in Mr. Farrell's testimony the same cross-currents and ambiguity as to whether it is the contractor's role, or one of the prerogatives of DOE to disseminate the technology generated by DOE contractors. I gather from his remarks that it is his view that it is a DOE responsibility. Whether that view derives from a DOE interpretation or from specific statutory language, I can't say, but I interpret his remarks to underscore the view within DOE that it should have a significant role in the dissemination of contractor generated technology.

I think that view—which, as I have said is already reflected in the Federal Acquisition regulations is the problem. The flow of technology from the Government-university-industry relationship must be clearly channeled through the university to its licensees. Those licensees cannot be subjected to the uncertainties and cross-currents that arise from knowing that the Government may, through some other distribution channel, also be making the technology available in some fashion. This is particularly true if the industrial licensee has invested significant funds to develop the technology further, and then it looks like the Government might piggyback its contractors on all of that effort.

Mr. Preston may want to add to that.

Mr. **Preston**. Yes, one of the comments I would like to make about the issue of requesting waivers and giving waivers, is that the timing in licensing technology is so critical that even waiting six months is quite often prohibitive in getting an effective license deal.

I will give you an example. Two months ago in the area that we have been discussing today, I was approached by a couple of faculty members who had come up with an invention related to superconductors, a technique for making these brittle ceramic into ductile wires. We filed for a patent less than a month after they came into our office, and have now licensed it to a private sector through a major venture capital firm who has a created a company to commercialize this technology. In less than two months, we now have

$1 million worth of private money invested into this technology. We have a company created, and we have a license agreement consummated and a patent filed.

If I had to wait six months or a year to get DOE waiver in order to move ahead with this, the venture community would probably be tied up in other deals and this would slow down getting the license done in the first place.

Another comment I wanted to make from the DOE paper that was submitted was that the DOE expressed considerable pride in the fact that there have been 27 start-up companies over the last year from DOE sponsored research, and 200 license agreements to major companies to commercialize DOE research.

MIT is perhaps a drop in the bucket to DOE total—we are less than one-tenth of their budget—our numbers are comparable. We are creating about the same number of new companies per year, and consummating about the same number of license agreements.

Mr. Price. All right. Thank you. We have another hearing about to begin. We thank you, Mr. Dummer, Mr. Carpenter and Mr. Preston, for your fine testimony and for your patience with us today.

The Subcommittee is adjourned.

[Whereupon, at 1:45 p.m., the subcommittee was adjourned.]

APPENDIX

SOUTHWEST RESEARCH INSTITUTE

GORDON H. MILLAR
Executive Associate

Detroit Office
[illegible]
[illegible]
[illegible]
[illegible]

17 May, 1987

The Honorable Doug Walgren, Chairman
Subcommittee on Science, Research and
Technology
Committee on Science, Space and Technology
U. S. House of Representatives
Suite 2321 Rayburn House Office Building
Washington, D.C. 20515

Dear Representative Walgren:

At the end of the Committee session last week, I was asked to draft some written comments with respect to H.R. 2068, a Bill sponsored by you, Mr. Boehlert, Mr. Brown, Mr. Glickman, Mr. Morrison and Mr. Ritter. The following comments reflect my reaction to reading H.R. 2068 and are consistent with both my written and verbal testimony at your Committee meeting.

In general, I endorse and support H.R. 2068. In my judgment, nothing is more important to the future of our country than an effort on the part of all of us to regain global competitiveness in the international markets. As I have testified before, we have let this competitiveness slip away because of our preoccupation with business manipulation rather than paying attention to the underlying technology and processes and product development, which is so important to manufacturing in an increasing technological world.

I have some concerns with certain specific phrases and some definitive language in H.R. 2068. Please consider, however, that my comments in no way detract from my endorsement of your Bill but are offered simply as enhancements as seen from a manufacturing position in the private sector.

As was discussed at some length during the hearings, few of us are enthusiastic about the use of the word, "competitiveness," in the title of any organization. I have thought about how we might replace the word, "competitiveness," and although others may have a better suggestion, I believe the use of the phrase, "industrial technology," might better convey what we really intend to do. I fully understand that competitiveness embraces more than just technology, but I must remind you and your Commitee that without a sound technological base, manipulation of the remaining business and trade activities can only be short term solutions.

I suggest that the National Bureau of Standards of the Department of Commerce shall"...after the date of enactment of this Act be known as the National Bureau of Standards and Industrial Technology."

In Line 12, Page 3, H.R. 2068 speaks to cooperative efforts between industries, universities and Government laboratories. Within our United States there are a number of institutions and foundations which are extremely active in the development of manufacturing technology essential to regain national industrial competitiveness. These institutions for the most part not-for-profit foundations are not included in any of the three classifications specifically cited in H.R. 2068. For example, a major institution which has made substantial contributions to manufacturing technology is Southwest Research Institute in San Antonio.

I appreciate that your Bill does not specifically exclude independent research organizations as it is silent in this area. I believe your Bill would be considerably strenghtened by adding independent research organizations to the groups cited in Section 3, Paragraph (3), starting on Line 12, on Page 3.

I am not clear on the origin and management of the fund introduced on Page 12. At the present time, the National Bureau of Standards receives about half its income from outside funded projects. The basic funding of the Bureau is in the range of $120,000,000, with an almost dollar-for-dollar funding received from projects which are pursued in the interest of industry. If I interpret the language of Paragraph B, the industrial funds now received by NBS would be deposited in a new fund to be managed by the Director in support of policy structured by a new board. The fund would be supplemented by the additional infusion of funds by appropriation as specified in Section 11.

It is my feeling that the funds currently attracted by the Bureau should not be included in the new fund, as they have become over the years an intrinsic part of the support pattern for NBS, and in my judgment restructuring this funding process would be counterproductive to the continued growth of Bureau activity.

I propose, therefore, that the fund identified in Section 10 be made up of funds attracted to this activity through new effort and supported by the appropriations in Section 11. I would not include in the fund those moneys now paid by industry in support of current NBS industrial activity.

I understand the thinking behind the creation of a new board, but I am unclear in how the new board would function.

At the present time, the Bureau of Standards is managed by a board called the Statutory Visiting Committee. This Committee is made up of a broad cross section of representation from industry and the academic world and is supported by a Board of Assessment and a number of Evaluation Panels. It was my privilege to chair for several years the Panel for the Evaluation of the National Engineering Laboratory of the Bureau of Standards.

It is my considered opinion that one high level board is all that is needed to manage the new organization. I would not create a new board reporting through independent channels and in conflict with the Statutory Visiting Committee of the Bureau of Standards. It may well be that a new high level board could be formed combining the new activity or the responsibility of the Statutory Visiting Committee and its title changed to accommodate the expanded scope of the new organization.

I am enthusiastic about the recognition on the part of yourself and others of the role that science and technology plays in the development of manufacturing and business competitiveness. I believe, however, that beyond the proposals made in H.R. 2068 we must begin to think in yet broader terms.

The real problem as I see it is the lack of recognition on the part of the parent Department of Commerce on the true role of science and technology in the business world. The Department of

Commerce has been preoccupied to a great degree with matters of trade, tariffs, customs and other manipulative activities, while the technology of our manufacturing effort drifted into obscurity. Our foreign competitors, particularly the Japanese, recognized the true role of science and technology in the development of superior products and the manufacturing processes to produce them. The Japanese have taken the science and technology of our United States and put it to work, while we devoted our time and effort to the almost counterproductive activity of business manipulation.

It may be a bit grandiose and very difficult to do, but I believe we must start now to change the basic culture of the Department of Commerce to truly take a leadership role in bringing to fruition the application of science and technology to our industrial processes. How this is done is beyond my scope of understanding at the moment, but I believe it is absolutely essential if we are to carry out our newly formed objectives of regaining competitiveness in world markets.

I appreciate very much the invitation to testify before your Committee and to offer these comments on H.R. 2068.

Best personal regards.

Cordially,

Gordon H. Millar

Gordon H. Millar

GHM/vmm

C: Messrs. Boehlert, Glickman, Brown, Morrison, Ritter
Mr. Lamar Smith, Mr. W. Woolam, Mr. F. Press, Mr. R. M. White,
Ms. C. Pompliano

REMARKS BY

Albert M. Navas

President

American National Metric Council

to the

U.S. HOUSE OF REPRESENTATIVES

Subcommittee on Science, Research, and Technology

Hearings on

H.R. 1964

The Metric Usage Act of 1987

April 28, 1987

Good morning, Members of the Subcommittee. My name is Albert M. Havas, and I am President of the American National Metric Council of Washington, DC, a private, non-profit trade association which provides information and planning services to manufacturing firms, educators, consumers, and professional and other trade organizations interested in voluntary transition to the metric system of measurement.

I appreciate this opportunity to discuss some of the advantages which would accrue as a result of passage of the bill you are considering, H.R. 1964, "The Metric Usage Act of 1987." This Bill requires Federal agencies to use metric in activities and procurement practices, with evolution to metric complete by 1992 wherever practical.

There are those who will tell you that because the Federal Government is the nation's largest customer, its changeover to metric will create complexity and confusion as agencies begin to use metric.

In fact, as in the private sector, the Federal Government uses metric measurement extensively now. Like the private sector, the government is realizing cost savings associated with combined metric use and rationalization -- an intelligent reduction of inventory items based on current utility.

The first of these instances is probably well-known to any of you with a liquor- or wine-producing industry in your state. In the late 1970's, the liquor industry, through its trade association, the Distilled Spirits Council of the U.S., DISCUS, asked the Treasury Department's Bureau of Alcohol, Tobacco, and Firearms Control, BATF, for new regulations to allow metric packaging. BATF agreed, and the industry used that opportunity to reduce the number of bottles in which liquor was packaged from 38 to an ultimate number of seven. The wine industry too reduced its number of bottle sizes to seven. That change has resulted in a number of benefits to those industries and BATF alike. Passage of this bill could result in even more.

- The cost to the industry to implement metric was $21 million, of which 60 percent was represented by new labels and obsolescence of out-moded bottle sizes. This amount represented less than 1 percent of the industry's annual sales of $3 billion.

- In comparison, the industry is estimated to have saved more than $8.5 million annually due to reduced inventory space requirements and cost savings realized through economies of scale in bottle production. One bottle mold alone cost $15,000 in 1977.

- This industry tried to select metric packaging consistent with the European Economic Community's. Since then, exports of wine and liquors have presented one bright spot in our balance of trade picture. In 1986, wine experts increased 15 percent over 1985; liquor exports rose 23 percent in 1986 compared to 1985. Metric packaging alone wasn't responsible for these export increases, but it certainly didn't hinder them.

- BATF, the government agency involved, realized savings because conducting its twice-monthly physical inventories for tax administration is much more efficient with seven bottle sizes to work with than 38.

- If Congress passes H.R. 1964, BATF and the wine and liquor industries could realize even more cost savings in tax administration because taxes are calculated on proof gallons instead of the liters in which these products are packaged. Making the conversions required is simple for larger producers, but is time-consuming and unnecessarily burdensome for smaller or fledgling wine producers in states such as Florida, Indiana, Michigan, Missouri, New Jersey, New Mexico, New York, Pennsylvania, Virginia, and Washington, all among the top 15 wine-producing states after California.

Another well-known instance of governmental metric use is the Department of Defense, DoD, setting the year 1990 as a target date by when procurement specifications and standards must be available in metric.

DoD notes three factors in its decision to use metric. One is the longevity of current weapons systems. A system on the drawing boards right now still might be in use 30 years after its introduction — to the year 2035 for a ship, for example. The second factor is related to the first — the availability of parts to service or repair long-lived weapons systems. In the future when U.S. industry is metric, DoD expects it will be a great waste of taxpayers' dollars to set up one production line specifically to supply inch/pound parts. The third factor in DoD's decision is our NATO allies' use of metric, because it is desirable for American materiel be inter-operable by European personnel.

One metric weapons system on DoD's drawing board is the Army's Light Helicopter Family, LHX, a $45 billion project which will result in 5,000 vehicles. This one helicopter will replace four different vehicles currently in use.

The metric dimensioning of the LHX entails benefits to both the contracting companies and governmental department involved in its production.

- The contracting teams are designing the engine for maximum ease of maintenance. The final engine design may require as few as one or two bolts for disassembly from the airframe. The current helicopters the LHX replaces require, as many as 200 hand tools for complete engine disassembly. The LHX is designed to use less than half that quantity.
- Its contractors believe they will be able to find foreign markets for the metric LHX engine which would not be available for an inch/pound engine. This could result in lower unit costs per engine. Often foreign sales of this type require an offset — that is, some foreign manufacture of the item. This offset would not be possible without metric. And, it may be possible for the contractors to trade the offset for a lower unit price per engine for complete U.S. manufacture. If so, this will result in retention of or an increase in U.S. jobs.

The contractors involved expected a high cost for training and parts, but have found the reality is much different. Contractors have found one 15- or 20-hour training course is sufficient to teach shop level and machine operators all the metric they need to know. They found their costs for metric hand tools minor. They found U.S. suppliers for both their metric tooling and fasteners.

In fact, a study made for the Department of Defense projects the cost of producing the LHX in metric most likely will add only three-tenths of 1 percent to its overall life cycle costs, and may add less, for an engine which is considerably easier to maintain and more useful than its predecessors.

A third example of government-private sector cooperation with a rationalized and beneficial metric result is the MUM Program, devised by the Department of Agriculture and the United Fresh Fruit and Vegetable Association. MUM refers to more efficient produce containers designed on the principle of Modularization, Unitization, and Metrication.

In the early 1970s, surveys revealed as many as 500 different container sizes used for shipping fresh produce. Working together, the Department of Agriculture and trade association specified a standard pallet size at 100 by 120 centimeters (40 by 48 inches). Using as few as 20 different container sizes, this standard pallet size can be loaded in 14 to 20 efficient patterns.

The result has been a reduction in what used to be three common problems in produce shipping: unbalanced loads, box collapse, and spoilage, with damage to the fragile contents resulting in losses to growers, shippers, and purchasers.

One growers' group, the Florida Tomato Committee, now estimates 75 percent of its members use MUM boxes. They are reinforced to withstand damage during mechanized shipping and unloading. Stacked more efficiently in one of the approved pallet configurations, ventilation is better. And the growers have realized cost savings in transportation because the pallets are loaded on a truck in 4 to 5 minutes, whereas it used to take an hour to hand-stack a load.

With 85 percent of their exports destined for Canada and the other 15 percent for Europe, metric-compatible boxes also have been helpful in enabling the tomato-growers to retain their export markets as well.

One customer who appreciates the savings in labor and warehousing resulting from MUM Program is the Department of Defense, which has advised its buyers and produce-growers it accepts and encourages shipments in MUM containers.

Produce-industry sources also expect some industry segments may realize cost savings due to economies of scale in their container purchases as they progress to fuller use of MUM boxes.

The benefits of metric will not stop at the federal level but also will spread to the state level, particularly in education, with passage of H.R. 1964. As you know, many states today are up-grading their education systems in response to the report A Nation at Risk, published by the National Commission on Excellence in Education in 1983. The nation's educational system likewise responded to passage of the "Metric Conversion Act of 1975": teachers now present both metric and inch/pound in their curriculum. Yet American children's measurement skills remain extremely poor: the Second International Mathematics Study, conducted in 1981 and 1982, showed U.S. eighth-graders ranked well below the 25th percentile in measurement skills. Out of students tested in 20 countries, only those in Swaziland and Nigeria performed worse. How much better would our children learn measurement if they could concentrate on only one system, if teachers could instruct in only one system, if publishers could present only one system, instead of dissipating their efforts? Not only would our children learn metric and measurement better, but textbook publishers, test preparers, and teaching aids suppliers could save money and pass those savings on to the local school districts if they concentrated on only one system. And our teachers would know they had prepared their students better for meaningful employment. Today it is recognized the brightest employment potential lies in high-technology jobs — and metric is the measurement system of high technology. To fail to teach measurement well, particularly metric measurement, is to disenfranchise our students of a vital skill necessary for their future success.

There are other examples of government metric use.

The Interior Department's U.S. Geological Survey is completing a very precise readjustment called the North American Datum of 1983 for the 270,000 horizontal control points of the National Geodetic Reference System. Of the 34 states involved in this very precise work, over 65 percent have chosen to measure in the metric system.

Congress also will consider in this Session passage of a draft Conversion of the Tariff Schedule of the United States into the Nomenclature Structure of the Harmonized System. If adopted this system will align the United States with the majority of the rest of the world in reporting import and export tariff and statistical data in metric units. These reports are prepared by another Treasury Department agency, the U.S. Customs Service. If one thinks of metric as a decimal system, it is not surprising the Treasury Department is so advanced in its use, since the Treasury also is responsible for one very commonly-used metric system — our currency.

Many industries in the private sector already enjoy the advantages of metric use — increased engineering efficiency, improved coordination of multi-national operations, an opportunity to rationalize inventory and operations, and improved export potential and competitiveness. Why should the U.S. Government deny itself these same advantages? With passage of H.R. 1964 our Government too can enjoy these same benefits.

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Focus on international trade

New metric markets, ventures encourage domestic use

The United States' international trade—exports, sold abroad, and imports, sold to us—has been described as one of the engines which drives the metric train. The United States comprises the largest, single-language, developed market in the world and is one of only three officially non-metric countries *(see "here & abroad," page 5).*

The U.S. imported more then $320 billion worth of goods from January through October, 1986, and in turn exported more than $180 billion to overseas markets, an increase in exports of 1 percent over the same period the preceding year, but nonetheless resulting in a 10-month trade deficit of $140 billion, according to figures prepared by the International Trade Administration (ITA), U.S. Department of Commerce (DoC), Washington, D.C.

Products manufactured for foreign trade are an important component of the Gross National Product (GNP), increasing from 4 percent between 1940 through 1970 to 8.2 percent of the GNP in 1982 according to

See "Trade," page 5

Chicago in November selected for Conference

ANMC's 13th Annual Conference has been slated for the Ramada O'Hare Hotel, Chicago, Illinois, running two full days, November 3-4 (Tuesday and Wednesday), 1987.

Board Chairman K.Y. Taylor, North American Tool Company, South Beloit, Illinois; Conference Planning Committee Chairman Paul Woessner, The SEC Companies, Oakbrook, IL; Board Member Dr. David Goldman, Argonne National Laboratories, Argonne, IL; and ANMC Staff Member Jane Holland met in November for initial planning and site and date selection.

Future *Metric Reporter* issues will detail the Conference theme, format, agenda, and speakers. Watch for further information! ☐

Cotton gin manufacturer adopts metric to reflect foreign demand

Although considered a "small" business—425 employees—Lummus Industries, Inc., Columbus, Georgia, is one of the world's two largest manufacturers of cotton and men made-fiber ginning and handling equipment.

Because half or more of its annual sales are made in foreign markets and the company believes it will give them an advantage in those markets, Lummus is in the initial implementation stages of a voluntary conversion to the manufacture of its products in the metric system. Its decision already has borne fruit in an international joint venture described below which will enhance the marketability of the company's products.

The cotton "gin," invented by Eli Whitney in the late 1700's, separates cotton seeds from fibers, and nowadays also refers to the factory in which cotton is processed. Such a plant includes an unloading system, fans to carry the raw cotton bolls to a dryer, as many as six gins which remove the seeds and other impurities and then lint from the cotton fibers, and a baler which compresses the fiber into a rectangle weighing 218.2 kg. The drying-cleaning-baling process also includes centifugal fans to remove impurities, blowers for transporting them elsewhere (the cotton seeds and husks often are recycled as either cattle feed or lighteners for the southern U.S.'s heavy clay soil), air pollution control equipment, belts on which the finished bales travel and machinery to move them, and electronic devices to control plant operations. The world's most advanced processing plant, which Lummus built, is located in California and has the capacity to produce such bales at the rate of one per slightly less than 70 seconds—51 bales an hour.

Each separate gin or full plant Lummus makes is custom-built to the customer's specifications, because cotton fiber varies according to the type grown, fiber length, the climate, and the speed with which the customer

See "Lummus," page 7

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meet the Board

G.T. Underwood

G.T. ("Gerry") Underwood brings a long history of personal, private-, and public-sector experience to his membership on ANMC's Board of Directors.

An Arizona native, Underwood spent much of his childhood in Mexico where he learned the metric system. He earned a Bachelor of Science in Industrial Engineering from the University of Southern California and began his career in the electronics industry, earning as well his license as an investment counselor.

Underwood joined Deere & Company, Moline, Illinois, in the late 1950's. A significant portion of his early career with the farm-machinery manufacturer was spent in Latin America and Europe; he then became manager of Deere's engineering standards administration, working to integrate its foreign and American functions. Because using two different measurement systems led to inefficiency, Deere decided to convert to the metric system, and Underwood coordinated the company's successful transition to metric.

During this time he chaired ANMC's Construction & Agricultural Equipment Sector Committee and served on the Board; he also was a member of the American National Standards Institute's International Standards Council and of the Society of Automotive Engineers. In February, 1984 he was named Director of the U.S. Department of Commerce's Office of Metric Programs; he also has been responsible for the Department's efforts in coordinating international research-and-development programs. Following a determination his Board membership posed no conflict of interest with government service, he resumed a seat on the Board when a vacancy occurred last year.

It is unnecessary for the U.S. to adopt a mandated timetable for metric transition because as world markets develop, the private sector will adopt metric due to increased involvement, communication, and interdependence with them, he believes. He points out the "social" side of metric, for example, dual-marked highway signs, is less important because as metric becomes the predominant business measurement system, a "self-regulating" environment will emerge in which people learn metric as they need to use it.

Underwood and his wife Marie are the parents of two daughters, Lynn, a physician currently conducting research in Northern Ireland, and Keri, an insurance company attorney living in St. Louis, Missouri. ☐

metric reporter

Deborah Odell Moss
Editor

The *Metric Reporter* is an official publication of the American National Metric Council, 1010 Vermont Ave. NW, Suite 320, Washington, DC 20005, (202) 628-5757. ©1987.

ANMC welcomes the expression of divergent viewpoints; unless otherwise stated, the opinions expressed in the *Metric Reporter* are not necessarily approved or endorsed by ANMC.

puzzles

Because many subscribers may have received the January *Metric Reporter* late due to heavy pre- and post-Holiday mail, the deadline for submission of the answers to either of the puzzles which appeared in that issue has been extended by one month *(see MR 1987-#1, page 4).*

Remember, the first two correct answers to the acrostic or mathematical puzzles will earn their submittors a famous ANMC "drink metric" coffee mug. So if you've half-way calculated the answers to either, you'll want to complete and send them in as soon as possible. ANMC's address appears at the left. Please remember to include your name and mailing address with your answer.

But don't delay—this is your last opportunity! The answers absolutely, positively will appear in the March issue! ☐

here
& abroad

Federal Metric Coordinators

The list below is of key U.S. agency and department Metric Coordinators, who also are members of the Metrication Operating Committee. Please keep in mind Federal personnel and telephone numbers are subject to change; the listing is current as of January 1, 1987. If you need more information on Federal metric policies, please contact the Office of Metric Programs at (202) 377-3036.

Agency	Contact	Telephone
Dept./Agriculture	Dr. Clare I. Harris	* 447-4423
Dept./Commerce	Gerald T. Underwood	377-0944
Dept./Defense	Col. Thomas E. Mansperger	695-7915
Dept./Education	William J. Phillips	245-8111
Dept./Energy	C. Warren Devereux	(301) 353-5638
Dept./Health and Human Services	John Taylor	485-0160
Dept./Housing and Urban Development	David C. Moore	755-0640
Dept./Interior	Roger Foster	343-4281
Dept./Justice	Harriet Fisher	633-1426
Dept./Labor	Donald E. Lemmon	523-6073
Dept./State	Peter E. Gurvin	235-3689
Dept./Transportation	Byron L. Nupp	366-5442
Dept./Treasury	S.F. Timothy Mullen	376-0413
Central Intelligence Agency	Anthony Zaia	281-8131
Commodity Futures Trading Commission	Donald L. Tendick	254-7556
Consumer Product Safety Commission	James I. Price	(301) 492-6494
Environmental Protection Agency	Deran Pashayan	475-8936
Export-Import Bank of the U.S.	Albert H. Hamilton	566-4652
Federal Communications Commission	Frank L. Rose	653-6288
Federal Emergency Management Agency	Henry Tovey	646-3540
Federal Maritime Commission	Newton Frank	523-5874
Federal Reserve Board	Michael Lesko	452-3415
Federal Trade Commission	Stephen Eklund	376-2891
General Services Administration	Mary McKeil	557-1930
Government Printing Office	George Collins	275-2873
Interstate Commerce Commission	Edward E. Gutherie	275-7480
Library of Congress	Floyd D. Hedrick	287-8605
National Aeronautics and Space Administration	Richard H. Weinstein	453-1871
National Science Foundation	Norman Caplan	357-9618
Nuclear Regulatory Commission	Karl Goller	443-7991
Small Business Administration	Sheryl J. Swed	634-6128
Smithsonian Institution	Jane Glaser	357-3101
Tennessee Valley Authority	D. Wesley Dalton	(615) 751-2831
United States Information Agency	Charles N. Canestro	485-8676
U.S. International Trade Commission	Erland Heginbotham	523-0146
U.S. Postal Service	Franklin J. Thurston	(301) 443-6266
Veterans Administration	Richard W. Echoff	233-3306
Office of Science and Technology Policy	Lee Rivers	395-5052
Office of Special Trade Representative	Donald S. Abelson	395-3063

*All telephone area codes are (202) unless otherwise indicated.

OMP reports

Editor's note: *This month's "OMP report" was prepared and submitted by Ruben H. Moller on behalf of the United States International Trade Commission's Metric Coordinator, Erland Heginbotham, Director of the Office of Industries. Questions you may have about this important metric change may be referred to Moller at (202) 724-1732.*

Conversion of tariffs to metric measures

In response to a request by President Reagan in September, 1981, the U.S. International Trade Commission published a draft *Conversion of the Tariff Schedules of the United States into the Nomenclature Structure of the Harmonized System* in June, 1983. The conversion, intended to replace the current *Tariff Schedules of the United States Annotated* (TSUSA) beginning January 1, 1988, was updated and republished in September, 1984, and again in November, 1986. As part of his request, the President directed that units of measurement be converted to metric units. In the conversion process, the Trade Commission solicited and received suggestions from the private sector, including the American National Metric Council, and various interested government agencies.

The converted tariff schedule is in the format of the proposed "Harmonized Commodity Description and Coding System," commonly known as the HS. The proposed HS was developed by the Customs Cooperation Council, an international customs organization based in Brussels, Belgium. It is expected that all the United States' major trading partners, including Canada, the European Community, and Japan, will adopt the HS format for their tariff schedules at the same time as the United States.

After World War II, a number of commodity classification systems emerged for the purpose of reporting production and trade of agricultural, mining, and industrial products. Most countries adopted either the Brussels Tariff Nomenclature (BTN) or the Standard International Trade Classification for the basis of imposing customs duties and collecting trade data; most of them employed metric units of measurement. However, a few countries, including the United States and Canada, developed their own unique product classification systems, using primarily inch/pound units of measurement. Canada since has converted to metric units for most of its products and dual reporting for the remainder. Each classification system is radically different from the other; the Harmonized System (which is based primarily on the BTN) is an attempt to standardize international reporting of trade.

In the *Tariff Schedules of the United States* (implemented on August 31, 1963), the five-digit tariff rate lines provide the legal descriptions and tariff rates for imported articles. The numbering and product scope of these five-digit items can be changed only pursuant to statutory authority. For statistical purposes, certain five-digit rate lines are sub-divided by adding two-digit statistical suffixes. These seven-digit statistical annotations have no legal force and are subordinate to the five-digit classification scheme. As in the current TSUSA, the proposed conversion has legal rate lines (at the ten-digit level) and statistical annotations (at the ten-digit level).

For about 96 percent of the 10,735 eight-digit items in the U.S. converted tariff schedule, the units of quantity are either in metric units or absent (i.e., imports are reported in terms of value only). Another 3 percent have dual reporting units, one of which is metric and the other inch/pound. The remaining 1 percent are in inch/pound units only.

Units of quantity that have metric designations are limited primarily to mass (weight): tons (t), kilograms (kg), and grams (g); length: meters (m), centimeters (cm), and millimeters (mm); area: square meters (m^2) and square centimeters (cm^2); and volume: cubic meters (m^3), cubic centimeters (cm^3), and liters (L).

Products in the converted tariff schedule that have two separate units of quantity designations for the same items (metric and inch/pound) are limited to articles of apparel and clothing accessories. In most cases, "kilograms" and "dozen" are assigned to each eight-digit item number.

The most often cited inch/pound designation for units of quantity in this document are: (1) barrels (bbl), for crude and refined petroleum oils, oil obtained from bituminous minerals, and certain other liquid and gaseous products; (2) kilowatt-hours (kWh), for electric energy; (3) dozen (doz.), for hats, headgear, mouth organs, frames and mountings for spectacles, goggles, and similar products; (4) dozen pairs (doz. prs.) for gloves, mittens, mitts, and lenses for corrective spectacles; (5) dozen pieces (doz. pcs.), for tableware, kitchenware, toilet articles, and similar items; and (6) gross, for bottles, jars, clothespins, nursing nipples, and other similar articles.

The implementation of its tariff schedule in the HS format will align the United States with the majority of the rest of the world with respect to using metric units of measurement in reporting imports and exports for tariff and statistical purposes. Considering that the value of U.S. imports for consumption in 1985 reached $343.6 billion, the conversion of the TSUSA to the use of metric measures will have a considerable impact on the increasing use of the metric system

See "OMP reports," page 5

"OMP reports," *from page 4*
in the United States. This is consistent with the spirit of the Metric Conversion Act of 1975, which states, "...the policy of the United States shall be to coordinate and plan the increasing use of the metric system in the United States...." ☐

Brunei

...And then there were two.

Developments in the Sultanate of Brunei indicate the world soon will be reduced to two countries which are not mandated to use the metric system. *(See, "Brunei, Burma, U.S. remain as three non-metric holdouts," MR 1986-#12.)*

Until recently Brunei, in addition to the U.S. and Burma, has been counted as a country not using the metric system. However, according to recent correspondence, "In July, 1986, it was officially announced that the metric system would be used for the whole country and an official launching ceremony is proposed for July 1987. There will be a proposed period of five years after the launch of the system to enable lay people to familiarize themselves with day-to-day use of the system to ensure that all the organization[s] go metric..."

The letter, dated December 7, 1986, is from Brunei's Permanent Secretary (Technical), Ministry of Development, Malai Ali Malai Hj Othman, to Ernst Lange, Huntsville, Alabama, a member of the U.S. Metric Association, who forwarded it to the Office of Metric Programs, U.S. Department of Commerce.

The Secretary's letter indicates several governmental departments and educational institutions already are in the process of converting, which was mandated by legislation, the "Weights and Measures Enactment, 1983."

New Jersey

Make that one and .980 countries.

The Senate and General Assembly of that State have passed and its Governor signed legislation which reads in part, "The inch-pound system of weights and measures in customary use in the United States *and the metric system or System International (SI) of weights and measures are jointly recognized and one or the other, or both...shall be used for all purposes in this State*....It is the intent of the Legislation that nothing in this section shall mandate the exclusive use of SI; however, its use within this State is encouraged.... (emphasis added)."

The legislation was sponsored by Senators Leanne Brown, Frank X. Graves, Jr., the late John P. Caulfield, and Paul Contillo; in the Assembly its sponsors were Robert J. Martin and Frank M. Pelly. The legislation was a bi-partisan effort, since New Jersey's Senate is controlled by Democrats and the Assembly's majority and the Governor are Republican.

MOC/ICMP

The Metrication Operating Committee, the working arm of the government's Interagency Committee on Metric Policy and whose members are the 39 Federal Metric Coordinators, held its Executive Board meeting on December 10, 1986. Among other issues addressed at the meeting were these developments:

- Following the Chernobyl nuclear reactor accident, confusion resulted from non-standard reporting of radiation units. Two efforts are under way to develop **standard international metric units** to correct this situation. The Oak Ridge National Laboratory has submitted a proposal to the Department of Energy to study means of agreement on standard radiation units for federal and private-sector use; the President's Science Adviser's staff has created an interagency radiation research group, including a metric sub-panel chaired by ANMC Board Member Dr. David Goldman, to examine this issue.
- Indications are field service equipment for the **Light Helicopter Family (LHX)** will be metric and repair personnel will use metric tools. LHX-specific depot items will be metric; standard depot items and repair will be metric or inch/pound based on turn-around time, needs, and cost.
- Its Metrication Steering Group (MSG) is preparing a draft revision of the **Department of Defense (DoD) metric policy** to state all elements of new designs will use metric and procurements of new systems will consider using metric when it is in DoD's best interests. In MSG's revised policy draft, *non-metric use* will have to be justified.

NTIS

The National Technical Information Service (NTIS) is making available for purchase "Guidelines for Metric Transition of Computer Software," originally prepared by ANMC's Data Processing/Office Equipment Sector Committee and adopted by the General Services Administration as a General Information Resources Management Regulation *(see "here & abroad," MR 1986-#12).*

To order, you may write NTIS, 5285 Port Royal Road, Springfield, Virginia 22161, or call (703) 487-4650. The price is $9.95 per copy; NTIS accepts orders charged to Visa, MasterCard, or American Express credit cards. Rush service is available at a premium in addition to the document cost.

When ordering, please be sure to include the NTIS document access code number: PB 86-240215/AS. ☐

"Trade," *from page 1*
research statistics in "The Role of Metric in U.S. Exports," a report prepared by J.F. Coates, Inc., Washington, D.C., for the U.S. Metric Board and issued ultimately by the DoC's Office of Metric Programs.

According to the same source, measurement-sensitive products account for one-half to two-thirds ($100 to $200 billion annually) of U.S. ex-

See "Trade," page 6

"Trade," *from page 5*

ports, a percentage which has remained constant since 1955. The report notes advanced industrial nations, all of which are metric, buy 60 percent of U.S. exports. Again, about half of what we import is measurement-sensitive, including oil and other bulk commodities, and about half of what we import comes from developed, metric countries.

The U.S. trade deficit is of great concern to businesses, politicians, and economists because it represents the loss of capital and jobs—and ultimately tax revenues—to the U.S. domestic economy. In a November 27, 1986 article in the Washington *Post*, incoming Senate Finance Committee Chairman Lloyd Bentsen (D TX) indicated one of the Committee's first priorities in the upcoming Session will be "non-protectionist" trade legislation.

The United States does not regard use of or demand for metric products as a trade barrier, says Donald Abelson, Director, Technical Trade Barriers, Office of the United States Trade Representative, Washington, D.C. An allegation that metric is a trade barrier is naive at best because one of a nation's sovereign rights is to choose its own measurement system; a more significant element of nonmetric use is that if a business wishes to export its products it must meet its markets' demands, he says.

In addition to those long-established trends which promote metric use in international trade, new trends are emerging which tend to further encourage its use.

New markets

The U.S. has been a leading developer of technology, which increasingly is expressed in the metric system. Fields in which the U.S. has been dominant include autos (now nearly 100 percent metric); farm machinery (metric and inch/pound mixed); chemicals, including agricultural, industrial, and pharmaceutical (increasingly packaged in metric); aerospace (not metric); and defense (beginning to become metric).

Markets which show potential for increased U.S. participation include telecommunications; biotechnologies and medical and biomedical engineering; new energy technologies; chemicals, particularly value-added specialty chemicals made from raw materials; space manufacture; and services, particularly construction and engineering; except for domestic construction, nearly all are increasingly metric, according to the report.

The European Economic Community

Nearly all non-Communist European nations, with a few exceptions such as Switzerland, belong to the European Economic Community (EEC). The EEC's imports to the U.S. run about $70 billion per year, 15 to 20 percent of the total, while our exports to the EEC run to $50 billion per year, about 25 percent of the total.

On February 28, 1979 the EEC Council issued a Directive establishing metric as the only legal measurement system in the Community after December 31, 1989, with "derogations" (exceptions) for certain British and Irish products, since those countries were in the process of conversion to metric.

After that date, trade must be conducted in metric labeling within the Community, according to Charles M. Ludolph, Director of the Office of European Community Affairs, ITA. The Directive does not act as a trade barrier but does not facilitate trade for U.S. manufacturers either. The Directive will affect primarily those U.S. manufacturers with British and Irish facilities who are not already using metric, he says.

The Harmonized System

The United States is a participant in a new trade classification system called the "Harmonized Commodity Description and Coding System" (HS) *(see "OMP reports," "here & abroad," page 4)*, developed by the Customs Cooperation Council, head-

See "Trade," page 7

U.S. INTERNATIONAL TRADE*
November, 1986

Product Category	(in billions of dollars) Imports	Exports
Petroleum Products	**3.0**	
Non-monetary Gold	**0.8**	**0.1**
Agricultural Products (meats, fruits, vegetables, wine, grains, animal feed, raw cotton, etc.)	**2.0**	**2.5**
Manufactured Goods	**29.5**	**12.8**
New Passenger Cars	4.9	0.5
Motor Vehicle and Tractor Parts	1.2	0.9
Trucks, Buses, and Chassis	0.8	
Aircraft and Parts		1.3
Clothing and Footwear	2.3	
Organic and Inorganic Chemicals		0.8
Telecommunications Equipment and Parts	2.3	
Office Machinery and ADP Equipment	1.6	1.4
Electrical Machinery	2.1	1.2
General Industrial Machinery	1.0	0.6
Specialized Industrial Machinery		0.7
Power Generating Machinery	0.9	0.8
Iron and Steel Mill Products	0.8	

*"Advance Report on U.S. Merchandise Trade," Bureau of the Census, U.S. Department of Commerce, December 31, 1986.

"Trade," *from page 6*

quartered in Brussels, Belgium. The U.S. Congress must approve the HS. If so, its provisions are expected to take effect January 1, 1988. Besides presenting a unified, standard commodity description system for international use, the HS also will report all export and import data in metric.

Paul Giguere, Director of the International Nomenclature Staff, United States Customs Service, Department of the Treasury, Washington, D.C., says the new reporting system will not make much difference in the way the U.S. collects tariffs, currently on an *ad valorem* basis, that is, a percentage of value. For example, quantities of raw silk or wool fiber now are expressed in mass while woven materials of these fibers are expressed in area. The fiber or cloth will have the same monetary value, so the tariff will remain the same; what would change under the HS is that statistics will report kilograms of fibers or square meters of fabric. In fact, Giguere says some reportage will be simpler, since the Customs Service has had to translate current metric figures into inch/pound.

Giguere, who chaired the U.S. delegation which worked on the HS, says the system is part of an effort to facilitate trade which extends back 100 years. These efforts were intensified about 1968-69, but a lack of uniform descriptions stymied this process. The actual work began in 1973 with a convention 10 years later to complete it.

Eugene Rosengarden, Director, Office of Tariff Affairs and Trade Agreements, International Trade Commission, DoC, Washington, D.C., the delegation vice-chairman, reports President Reagan formally wrote the delegation in 1981 to request metric's use in the document. "By this request we are reflecting the realities of international trade," he says, adding the delegation used some ANMC documents in its work.

Both Giguere and Rosengarden say those companies active in trade said little about the new system other than to approve the fact trade statistics will be metric, since exports are ordered and imports furnished in that system.

The HS represents a "never-ending task" as it is further revised to accommodate new technologies such as fiber optics and semi-conductors, Giguere says, adding the work on the classification system and comparability of statistics are more meaningful aspects of the HS than its metric reportage.

International joint ventures

The United States' unique position as the largest common-language market sometimes has acted as a detriment in international trade, since Americans have not needed to understand other cultures and languages as have the more geographically-compressed Europeans, for example.

One trend counteracting this cultural bias is the increasing engagement of U.S. firms in international joint ventures such as marketing and licensing arrangements and U.S. businesses' partnerships with local firms, according to Brant W. Free, Director, Office of Service Industries, ITA: "a lot of what we're selling abroad is high technology and expertise," he says. These arrangements offer a number of advantages, including a more efficient use of resources; the local partner's greater understanding of the market and easier access to financing; and greater American control of product technology. These ventures enable American companies to become not just a seller but a presence in a local market.

These ventures also reinforce the increasing trend toward internationalization, in which a product might be designed in one country, its parts built in a second, assembled in a third, and sold in a fourth, as is often the case with complex machinery. Such internationalization, with its need for a common technical language, encourages metric use, Free expects.

G.T. Underwood, Director, Office of Metric Programs (OMP) *(see "meet the Board," page 2)*, who has worked extensively on promotion of such ventures for the Office of Productivity, Technology and Innovation, of which OMP is a part, says increasing internationalization is not mere "trade" but more accurately is described as "world business" in which American firms do not force acceptance of their products in a local market but participate and interact in the market by integrating their operations into it.

Such efforts will result in "sensible accommodation" or "strategic adaptation" of metric in the United States as its businesses become more internationally-oriented: "the metric issue will be driven by economics, not by predetermined actions," he says. As U.S. firms look outward, there will be a corresponding emphasis on metric in mathematics, geography, and languages in education, all of which will reinforce each other as well as the "world business" attitude, Underwood believes.

"The attitude we are trying to inject into the strategy of American business...[is] that world markets are exciting markets. They're not only the best markets in town, they're the largest," he says. As more American businesses adopt that posture in an effort to increase their sales and profits in their own self-interest, the more they will bring increasing metric acceptance and use along in their wake. ☐

"Lummus," *from page 1*

wants the cotton processed.

Man made fiber-handling equipment includes tow cutters to cut the processed fiber into the customer's desired length, condensers which remove air from the fiber, and balers.

A mill also might include mixing feeders to combine several types of cotton, or cotton and man made fiber blends, into a finished product.

Charles Hamilton, Executive Technical Coordinator for the firm, notes little processing is done by hand these days even in less-developed countries where lower personnel costs might be expected to encourage hand-processing.

Because its products are so individually adapted to each customer's needs, Hamilton says the firm's

See "Lummus," page 8

anmc activities

- ANMC staff and subscribers hosted an informal breakfast Thursday, December 18, 1986 for Congressional staff members who have supported metric issues in the past and expressed an interest in becoming more knowledgeable about such issues in preparation for the upcoming 100th Congressional Session.
- The American National Standards Institute, New York, New York, has appointed William F. Hanrahan of the Computer and Business Equipment Manufacturers Association (CBEMA), Washington, D.C., to its Executive Standards Council. CBEMA provides the Secretariat for the **Data Processing/Office Equipment Sector Committee.** ☐

calendar

Unless otherwise noted, all meetings will take place at ANMC. Meetings marked with an asterisk (*) have been changed from previous date, time or location. For further information, contact the ANMC Program Department at (202) 628-5757.

2/5/87	**ANMC Board of Directors,** Washington, D.C., American Petroleum Institute, 10 am-3 pm.
2/5/87	**Conference Planning Committee,** Washington, D.C., American Petroleum Institute, 3:30-5:30 pm.
October	**Forestry Sector Committee,** Minneapolis, MN, location, time TBA.
October	**Construction & Agricultural Equipment Committee's Materials Task Force,** Chicago, IL, location, time TBA.
11/3-4/87	**13th Annual Conference,** Ramada O'Hare Hotel, Chicago, IL, times TBA. ☐

"Lummus," *from page 7*

machines are assembled from sections rather than on an assembly line. The company uses two Weidemann Division (of Warner & Swasey, King of Prussia, Pennsylvania) tooling machines to make small batches of 10 to 20 piece parts at a time, in either metric or inch/pound specifications (see, *"Focus on manufacturing: Automation of production can enhance metric use,"* MR *1986-#6*).

Because the firm's conversion process is in its initial stages it is too early to determine the impact transition might have on production and design economies, Hamilton says, adding that shop workers accept the system easily provided they have the proper metric tools.

On the other hand, going metric has had a positive affect on at least one aspect of Lummus's operations: the firm has entered into a joint venture, Lummus-Hubei Machinery Company Ltd., with the Peoples' Republic of China, in which Lummus has engineered and built in metric a prototype 40-saw gin (a state-of-the-art machine contains as many as 158). The new gin offers the Chinese the flexibility to process amounts as small as the single-farm output now ginned by the farmer while providing the greater capacity the Chinese will need as they centralize their ginning operations. The gin is as efficient as larger-capacity machines; its product equals their quality. The Chinese will build gins in the future to this design; Lummus will adapt several of its features, including its metric engineering, into larger-capacity gins which it will market abroad.

"The desire to sell [our products] abroad and to give our people abroad an edge over our competition" led Lummus to decide to go metric, Hamilton says, adding that so far it appears the firm's decision has proved correct.

Editor's note: *Hamilton was a participant in the Industry Panel at ANMC's 12th Annual Conference, September 22, 1986.* ☐

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STATEMENT

OF

CARL A. BECK

ON BEHALF

OF

NATIONAL SMALL BUSINESS UNITED

BEFORE THE

SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HEARINGS ON

HR 1964, METRIC USAGE ACT OF 1987

APRIL 28, 1987

1155 15th Street N.W. Suite 710, Washington, DC 20005 (202) 293-8830

STATEMENT OF
CARL A. BECK
ON BEHALF OF
NATIONAL SMALL BUSINESS UNITED
BEFORE THE
SUBCOMMITTEE ON SCIENCE, RESEARCH & TECHNOLOGY
HOUSE COMMITTEE ON SCIENCE, SPACE & TECHNOLOGY
HOLDING HEARINGS ON
H.R. 1964, METRIC USAGE ACT OF 1987
APRIL 28, 1987

Mr. Chairman and Members of the Committee:

My name is Carl A. Beck. I am the President of the Charles Beck Machine Corporation of King of Prussia, Pennsylvania. I am appearing today on behalf of National Small Business United. NSBU is a new national trade association formed from the recent merger of the National Small Business Association, a multi-industry trade association founded in 1937, with Small Business United, a coalition of regional, state, and metropolitan small business associations organized in 1981. NSBU represents over 50,000 small businesses nationwide.

The Charles Beck Machine Corporation manufactures industrial machinery for the paper, film, foil, and textile converting industries. Although we employ less than 50 people, approximately five to ten percent of our machines are exported -- to Canada, Europe, South Africa, Australia, Japan, South America, and other industrialized areas throughout the world. Although the output of our export machines is in metric units, as customers in the rest of the world request, the actual manufacture of the machines is naturally in inch-pound units.

Our company participated in the original National Bureau of Standards Metric Study in 1972, and I was privileged to represent the interests of small business on the United States Metric Board.

The problem of Metric Transition has, today, become predominately a problem of the smaller manufacturer. Most of the large multi-national firms have essentially completed their transitions and, today, their new products are designed in the international SI units; thus, technical data and processes are interchangeable among their various manufacturing facilities around the globe. They have been able to make this transition unilaterally because of their volume. The automobile manufacturers, for example, provided detailed specifications to their suppliers, most of whom -- incidentally -- are small businesses, and worked with them closely during the transition period. The Metric Board study found that in such an environment, manufacturing to metric specifications is not difficult. But for small businesses with a proprietary product, the situation is quite different. Whereas General Motors orders a type of instrument by the millions, when we ship a machine to Germany it may have one air pressure gauge, which, of course, must read in kilopascals instead of pounds per square inch. Incidentally, our current metric pressure gauges are imported from Switzerland, since they are not yet manufactured in this country. Since we buy our parts "off the shelf" or from catalogs, we are limited in our purchases to what is available, and the metric readout item is often available only on special order and, naturally, more expensive. As a result, we are hamstrung in our need for standardization and cost reduction because too few suppliers have been able to establish a demand for metric components. If indeed we are to compete in markets outside the United States, small businesses such as ours need cost-competitive metric components. The proverbial response is usually that there will never be a significant demand for metric components if the world's biggest customer -- the United States Government -- is unwilling to recognize the inevitability of SI metric usage.

I could cite many situations and instances of the need for metric adoption if the U.S. is to compete successfully in world markets. The essence of the problem is that for small manufacturers to export their product, it must be metric on the outside; instrumentation and written operating procedures must also be metric. By and large, use of English language is almost universally acceptable, but the use of our inch-pound language is not. Also, there is a growing need to have major portions of the machine metric internally, to facilitate its maintenance and adjustment.

But small businesses like ours cannot make such a transition alone. It requires a building of co-ordination within the economic structure in which we live. Any impetus in this direction is not possible unless the United States Government is willing to take the lead, to recognize that we must live in a world universally metric, and participate in that world's international trade.

I have been asked why small business has not taken a stronger position on this matter. Even though the Pennsylvania Delegation to the White House Conference on Small Business passed a resolution for Congressional action, it did not make the final White House Conference top 60 recommendations. This is not surprising when we realize that over half of the delegates were in service industries and many of the remaining were interested in government contracting, or (if they were manufacturers of a proprietary product) had no expectations of selling in more than domestic markets, perhaps local markets. It was not that these small business people were against metric transition. There were just so many other problems affecting all small business that this subject was not as popular. As best as I have been able to observe over the last two decades, small business will accept metric usage as long as it is not MANDATORY for the private sector, with which I concur.

Those of us in small business who do not (nor want) to export are in favor of the Government leading the way, as H.R. 1964 proposes; the rest of the small business community is neutral. I have heard from other small business organizations, and the general consensus is that all are willing to see the Government move forward, even though small business in general is not willing to give it top priority.

But there is one aspect of metric transition which, from the small business viewpoint, is very important: the Federal Government effort must be co-ordinated. We in small business have lived too long in a confusion of not knowing to what part of the Federal Government to turn when we need information. The Interagency Committee on Metric Policy and its operating arm, the Metric Operating Committee, have for many years done an excellent job of co-ordinating the 40 or so agencies of the Federal Government into a consensus of plans and programs to meet the needs of both the public and private sectors, within the limitations of the Metric Conversion Act, for the problems of metric conversion which have faced us. I would hope that either implicitly or explicitly the ICMP and the MOC can continue to be a major co-ordinating factor to best implement the directions of this legislation. I have been privileged to work with this group over the years, including being the representative from the U.S. Metric Board, for a period embracing five successive chairmen, and cannot commend too highly the valuable contributions this group has made. Because of its universal acceptance by the various agencies, it has great potential to make further, significant contributions to this effort.

I hope these comments from a small businessman personally involved in this subject for two decades may lend some support to the acceptance and passage of this legislation.

Thank you for the opportunity to share the small business perspective. I'd be happy to answer any questions you might have.

For Record

FMC Corporation

Chemical Research and Development Center
Box 8
Princeton New Jersey 08543
609 452 2300

April 23, 1987

FMC

U.S. House of Representatives
Subcommittee on Science, Research
and Technology
RHOB 2319
Washington, D.C. 20515-6305

Attention: J.H. Turner

Gentlemen:

It would be very much appreciated if the attached remarks could be included in the discussion of H.R. 1964, "The Metric Usage Act of 1987".

Thank you very much.

Cordially,

Jack G. Lowenstein

Jack G. Lowenstein
Director of Administration

JGL:klb

attachment

cc: A. Navas, ANMC

Remarks By

Jack G. Lowenstein
Director of Administration
Chemical Research and Development Center
FMC Corporation
Princeton, New Jersey

Testifying in the capacity of:
Chairman, Chemical and Allied Products Sector
(CAPS) - Sector 1.02
American National Metric Council
Washington, D.C.

to the

U.S. House of Representatives

Subcommittee on Science, Research and Technology

Hearings on

H.R. 1964

The Metric Usage Act of 1987

April 28, 1987

Good morning, Members of the Subcommittee. My name is Jack G. Lowenstein, and I am making these written remarks in my capacity as Chairman of the Chemicals and Allied Products Sector of the American National Metric Council. I thank you for this opportunity to today discuss with you H.R. 1964, "The Metric Usage Act of 1987."

I believe passage of H.R. 1964 would result in a variety of benefits and advantages in both the private and public sectors.

The metric system is an elegant system of measurement, noted for its utility, its simplicity and ease of use. The fact that almost all countries in the world have adopted it indicates that it has considerable merit and advantages over other systems of measurement.

Our current system, on the other hand, is marred by a profusion of units, unclear and difficult to memorize conversion factors, and no rational basis in fact. The scientific world long ago recognized that a consistent system was an absolute necessity --- and standardized on the metric system (the "System Internationale", or S.I.).

(more)

It can further be shown that our citizens are quite willing to accept this new measurement system, especially if they are shown that it is to their advantage. I point to the fact that we Americans have accepted, with no difficulty at all, Liter-sized soda bottles, photographic film sizes in millimeters, metrically sized skis, metric medicine doses, and automobiles manufactured with metric fasteners.

But the major advantage to our adoption of the metric system will be our ability to compete favorably in foreign markets, where the consumer demands measurements in terms he can understand: Metrics! It is an unfortunate, but true, fact that the United States can no longer demand that other nations accept its products --- or do without. No, the foreign consumer is now offered many options for the products he needs and he is able to get them on his terms. We are at a definite disadvantage in the global marketplace when we can not match our competition's flexibility.

While it has been assumed that re-tooling for metrics is expensive, experience has shown otherwise. Respondents to a 1982 survey done by the J. F. Coates Corporation of Washington, D.C., stated that the conversion had been "no big deal!" American automobile manufacturers have been able to

(more)

produce cars with metric fasteners and other components without affecting the overall cost. Chemical manufacturers who ship to foreign markets have converted to "hard metric" packaging with ease and without hardship. The use of computers allows us to produce shipping and billing documents in either measurement system at the push of a button.

Those manufacturers who are able to produce goods in both the conventional and the metric systems are indeed able to supply the markets of metrically-oriented nations, but they still are disadvantaged by the necessity for dual inventories: One set of products to supply the American market, another set to supply off-shore demands. It is a sad situation that even some of our states put a roadblock in the path of the dual-system manufacturer by requiring specific product labeling which may inhibit the acceptance of that product in a foreign market!

Our balance of trade deficit amounts to almost two hundred billion dollars; having the wrong measurement system built into our products has almost certainly contributed to that shocking statistic!

(more)

In our ever-shrinking world, in a global market place, there can be only one system of measurement; The United States of America is the lone hold-out, whereas the rest of the world has voted for the metric system. Why do we insist on fighting a losing battle, when the alternative is a clear step ahead for everyone?

Our school children are saddled by a complex system: Odd and strange numbers have to be memorized and conversion factors are learned by rote, with little background or explanation. The number of feet in a mile, the number of ounces in a quart, the number of pints in a gallon, the foot-pounds in one horsepower, and so on ad nauseum, are all confusing and seemingly arbitrary. How do children in a metrically-knowledgable society fare? Very well, indeed: Only one factor is required, and that factor is "ten" (10). All measurements are consistently related and are conveniently sized by means of a single set of prefixes. The terms "milli", "centi", "deci", "kilo", "mega", etc., are all related by that factor of 10, and no odd numbers are ever required to relate one set of measurements to another. Wouldn't we also be smart in relieving our youngsters of an onerous and clearly out-dated system and letting them use their learning powers for more important matters?

(more)

Educators, curriculum developers and textbook publishers have received mixed signals from the government and the public sectors on the importance of the use of the metric system in education, and therefore our school texts do not stress metrics (although the scientific courses in high-schools and colleges indeed utilize metric measurements). However, if our government encourages the use of the metric system and shows its support by legislation such as H.R. 1964, then the message to the education sector becomes clear: Teach the metric system to our students!

Yes, it will take some effort --- and some money --- to convert to the metric system. But surely the examples set by others, as for instance our good neighbor to the north, Canada, have shown that conversion to this convenient and practical system of measurement can be accomplished with very little pain indeed. The cost in terms of time, effort and dollars is very small when we compare it with the benefits we can reap by accepting the metric system and the judgement of the rest of the world:

(more)

Competitiveness in a global market place;
Component parts interchangeability;
Reduction of inventories;
Reduction in the number of odd package sizes;
Ability to use one set of tools;
Universality of the language of measurement;
Easier-to-learn system of measurement;
Easier-to-use system of measurement;
Easier-to-memorize system of measurement;
Logical and consistent, and inter-related, system of measurement.

I urge you to consider all the benefits of the metric system of measurement, and compare them to the out-dated, inefficient, cumbersome, difficult to learn and impossible to explain inch-pound-gallon system we now use in the United States --- and then recommend the support and passage of H.R. 1964. As we approach the 21st century, let us insure the continued leadership of the United States, of which we have been so proud for over 200 years, by advocating, promoting and encouraging the use of this universal measurement system, the **Metric System**.

Thank you very much for giving me this opportunity to share my considered thoughts with you. I am personally encouraged by the introduction of H.R. 1964, as I can see that the work in which I have been involved for many years will indeed now bear fruit. For that you have my gratitude.

Jack G. Lowenstein

U. S. Metric Association, Inc.

A nonprofit organisation . . . established in 1916

~~10245 Andasol Avenue, Northridge, California 91325 ■ (818) 368-7443~~
255 Mountain Meadows Road
Boulder, CO 80302-9804

Honorable Claiborne Pell
United States Senate
Washington, DC 20510

1987-04-22

Dear Senator Pell:

I just learned from Ken Taylor that H.R. 1964 will be heard on 28 April by the House Science, Space and Technology Committee. The bill as read to me by Mr. Taylor is weak in several respects for the following reasons. It is unfortunate that H.R. 1964 was written without ever consulting officers of USMA who have been working for metrication for many decades.

o A metric board is no longer necessary or advisable, since most of the preparatory investigation and planning for metrication has already been accomplished. The new bill should call for repeal of those sections of the Metric Conversion Act which refer to it.

o More emphasis on the need for completing metrication to improve our competitiveness in world markets is necessary.

o Metric education in our school systems should be universal and primary.

o The original Act calls for a "modified" SI which is a violation of the Metre Convention. According to Article IV of the U.S. Constitution, "....all Treaties made....shall be the supreme Law of the Land."

o The continued use of two major measurement systems, side by side, the SI and inch-pound, is uneconomical and inefficient. The sooner this dilemma is resolved, the better for the nation.

USMA President Lorelle Young, Executive Director Valerie Antoine, and I consulted and wrote what we consider a far superior bill to H.R. 1964. We hope you will consider our draft as a basis for preparing a Senate version of the Metric Usage Act of 1987.

Sincerely,

Louis F. Sokol

Louis F. Sokol
President Emeritus & Editor

encl: draft of legislation

cc: Ms. Young
Ms. Antoine
Mr. J. Turner, Chief Counsel, House Committee on S. S. & T.
Honorable David Skaggs
Honorable William Armstrong
Honorable T. E. Wirth

LFS/jh

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Draft wording recommended by Louis F. Sokol to replace Congressman George Brown's original draft.

100th Congress, 1st Session H.R.

SECTION 1. SHORT TITLE.

This Act may be cited as the Metric Usage Act of 1987.

SECTION 2. FINDINGS.

Section 2 of the Metric Conversion Act of 1975 is amended by adding at the end thereof the following new paragraphs:

(3) World trade is increasingly geared towards the metric system of measurement.

(4) Industry in the United States is at a competitive disadvantage when dealing in international markets because of its cumbersome, non-standard measurement system; and industry is sometimes excluded from international markets when it is unable to deliver goods which are measured in metric system units.

(5) The inherent simplicity of the metric system of measurement and standardization of measurements has led to major cost savings in certain industries which have converted to that system.

(6) The Federal Government has a responsibility to develop procedures and techniques to assist industry as it converts to the metric system of measurement.

(7) The nation's adhering to inch-pound measurements handicaps school children, who must fill the metric jobs of tomorrow, because:

(a) Students lack the advantage of using the easier metric system; therefore, their understanding of technical and scientific subjects results in lower grades in science and mathematics.

(b) Young people entering the job market are encountering queries, on job application forms, regarding the applicant's ability to use the metric system.

(8) The metric system of measurement can provide substantial advantages to the Federal Government in its own operations.

SECTION 3. POLICY.

Section 3 of the Metric Conversion Act of 1975 is amended to read as follows:

(1) to designate the metric system of measurement (i.e. The International System of Units as established by the General Conference on Weights & Measures in 1960 and known as SI) as the official measurement system for United States trade, commerce, and Government.

(2) to require the use of the metric system of measurement in all Federal Government programs and procurements by the end of the fiscal year 1991, except where such use can be proven to be impractical or can be shown to cause significant inefficiencies.

(3) to seek out ways to increase the understanding and usage of the metric system of measurement by the general public.

(4) to direct the U.S. Department of Education to promote the teaching of the metric system as the prime measurement system in all public school curricula, so American youngsters will have the advantage of the sound, technological education necessary to make a living today.

The Metric Conversion Act of 1975 shall be amended by deleting sections 4 through 11 as inapplicable in the Metric Usage Act of 1987, due to the revision of section 3, and by substituting the following:

SECTION 4. IMPLEMENTATION.

The Metric Usage Act of 1987 shall be adminstered by the U.S. Secretary of Commerce through the Commerce Department's Office of Metric Programs.

SECTION 5.

(a) As soon as possible after the date of the enactment of this section, each agency of the Federal Government shall issue regulations to carry out the policy set forth in section 3 (with particular emphasis upon the policy set forth in paragraph (2) of that section), and as a part of its annual budget submission for each of the first 5 fiscal years beginning after such date shall report to the Congress on the actions which it has taken during the previous fiscal year, as well as the actions which it plans for the fiscal year involved, to implement fully the metric system of measurement in accordance with that policy. As used in this section, the term "agency of the Federal Government" means an Executive agency or military department as those terms are defined in chapter 1 of title 5, United States Code.

(b) At the end of Fiscal Year 1991, the Comptroller General shall review implementation of this Act, and report his findings to the Congress along with any legislative recommendations he has upon completion of such study.

Litton GUIDANCE & CONTROL SYSTEMS
5500 Canoga Avenue, Woodland Hills, California 91365 (213) 715-4040
Mail Station 50

27 April 1987

Robert C. Ketchum
Counsel
House of Representatives Committee on
Science, Space, and Technology

Dear Mr. Ketchum:

I have been reviewing HR 1964, and find the current text somewhat confusing. As an engineer who heads a group that is involved in drafting specifications and standards, I cannot understand why HR 1964 was drafted in such a strange manner, and would appreciate your checking on the matter before the bill is approved as currently set up, because it gives the impression that the person who wrote it didn't read the Metric Act of 1975 very thoroughly.

The text indicates that Section 3 in HR 1964 replaces Section 3 in the Metric Act of 1975. Then it says nothing about deleting Sections 4 through 12, although revising of the Act's Section 3 deletes the requirements for the U.S. Metric Board (USMB).

Section 4 of the Metric Act of 1975 defines terms that no longer apply to the revised bill, so should be deleted. Section 5 describes the makeup of the USMB (which no longer belongs in the Act because the USMB requirement has been deleted). Sections 6 through 8 are extraneous because they describe duties of the nonexistent USMB. Sections 9 through 12 describe USMB member reimbursement, its allowed staff, and finances . . . all invalid for the HR 1964 bill which has deleted the USMB requirement from the Act.

Enclosed is a suggested rewrite of HR 1964 which would be less confusing to a person reading it. I hope you will consider making at least some of these recommended changes.

Valerie Antoine
VALERIE ANTOINE
Manager, Support Services

Suggested text for HR 1964

A BILL

To amend the Metric Conversion Act of 1975 to increase the use of the metric system of measurement in the United States

Lines 1 thru 9 on page 1 read well.

Lines 1 thru 19 on page 2 reads well; then add:

(8) The nation's adhering to inch-pound measurements handicaps school children, who must fill the metric jobs of tomorrow, because:

(a) Students lack the advantage of using the easier metric system; therefore, their understanding of technical and scientific subjects results in lower grades in science and mathematics.

(b) Young people entering the job market are encountering queries, on job application forms, regarding the applicant's ability to use the metric system.

Lines 20 thru 24 on page 2 read well.

Replace lines 1 thru 17 with the following:

(1) to designate the metric system of measurement (i.e., the International System of Units as established by the General Conference on Weights & Measures in 1960 and known as SI) as the official measurement system for United States trade, commerce, and Government.

(2) to require the use of the metric system of measurement in all Federal Government programs and procurements by the end of the fiscal year 1992, except where such use can be proven to be impractical or can be shown to cause significant inefficiencies.

(3) to seek out ways to increase the understanding and usage of the metric system of measurement by the general public.

(4) to direct the U.S. Department of Education to promote the teaching of the metric system as the prime measurement system in all public school curricula, so American youngsters will have the advantage of the sound, technological education necessary to make a living today.

Replace lines 19 thru 21 on page 3 with the following:

The Metric Act of 1975 shall be amended further by deleting Sections 4 thru 11 as inapplicable in the Metric Usage Act of 1987, due to the revision of Section 3, and by inserting the following:

Lines 22 thru 25 on page 3 and all of page 4 read well.

National Conference of Standards Laboratories

1987
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March 31, 1987

James. H. Turner, Jr., Esq.
United States House of Representatives
Committee on Science and Technology
2321 Rayburn Building
Washington, D.C. 20515

Dear Mr. Turner:

It is our understanding that in the near future the Committee will begin considering various proposals under the general topic of improving American competitiveness. As you know, we firmly believe that any such improvement depends on the revitalization of the National Bureau of Standards. In our review, we have considered all aspects of the current mission of the Bureau, including that which we believe is absolutely essential - the delivery of measurement and calibration services.

Included as an attachment to this letter are the following:

Attachment 1. A brief paper titled "Revitalizing the National Bureau of Standards - An Investment in American Competitiveness." This paper describes our view of the Bureau mission, some thoughts on budgeting that mission, a listing of broad mission initiatives including proposed increases in budgets, and an exhibit prioritizing the measurement needs within the first mission initiative.

Attachment 2. NCSL's NMRC 86-01, Rev. 1, February 1987 which ennumerates the national measurement requirements now seen by industry.

Attachment 3. The Tri-Service Metrology Research, Development and Engineering Plan (Vol. 1), September 30, 1985 which describes the DoD's measurement requirements.

Attachment 4. The IEEE's PNMS Report which identifies national measurement requirements important to the microwave community.

We have been pleased to be able to work with you on issues impacting the NBS. Should you have any questions on this material or should you think we could help in other ways, please give me a call.

Sincerely,

Ed Nemeroff

Ed Nemeroff
President

1800-30th Street, Suite 305B • Boulder, Colorado 80301 • (303) 440-3339

REVITALIZING THE NATIONAL BUREAU OF STANDARDS -
AN INVESTMENT IN AMERICAN COMPETITIVENESS

INTRODUCTION

In this ninth decade since the founding of the National Bureau of Standards, it is appropriate to consider its contribution to American competitiveness and the role of the NBS in our reawakened interest in this important undertaking. As the Congress debates a number of far-reaching initiatives concerning the National Bureau of Standards, the National Conference of Standards Laboratories believes it is also important to consider the role and missions of the Bureau and its significant potential for contributing to America's competitiveness in international trade in the tenth decade of the Bureau and beyond.

The Bureau is a multi-purposed laboratory function of government with the principal focus of supporting American industry. The services provided by the NBS - information (such as engineering data, documentary standards, measurement methods, etc.) and services (such as reference materials, calibration services, measurement services, etc.) - are "public goods." Encouragement of their wide-spread use betters the entire economy. But, a "public good," with a benefit to the economy as a whole, must be an investment of government; there is little (if any) return to a specific industry (let alone an individual company) to justify investment in providing "public goods."

During the past twenty years, we have watched - almost helplessly - as the winds of budgets and the hurricanes of added NBS responsibilities have buffeted the Bureau. It is almost miraculous that the basic edifice has been able to withstand this continuous assault. Although there has been damage from these various buffetings, we are confident that this reexamination and the expected revitalization of the National Bureau of Standards will be able to repair the areas affected and to return the Institution to its rightful place in the forefront of measurement.

The remainder of this Introduction will be divided into two components. The Role and Missions of the Bureau and the Budgeting of Fundamental Resources.

1. **Role and Missions**

The difficulties which have arisen in the past have derived as much from this component as from the next (budget). The Bureau was established and indeed has been exemplary as an institutton that promotes the measurement mission of science, industry and commerce. The perception that the Bureau is a national resource for almost any type of laboratory work, however, has led to the addition of activites and responsibilities not directly apparent in the Organic Act. Coupled with the "lead agency" concept, which specifically requires that the Goverment agency with a programmatic mission fund or budget the NBS for that mission's measurement aspects, the Bureau has seemed to develop into a "job shop," with a number of its measurement missions being directed from outside. When these two factors (added scope and lead agency) are combined with the lack of a basic and continuing funding base, the Bureau is forced to make difficult and usually disasterous (from the standpoint of activities curtailed) priority decisions.

The NBS conducts research into measurement phenomena, both in fundamental and applied arenas. The output of this research has potential value for the nation's scientific knowledge base and for the understanding of measurement which is necessary to carry out the principal role of the Bureau: transfer to others in the form of information or services. The development of standards and methods of measurement absolutely depend upon research conducted and/or participated in by NBS scientists. The subsequent development of standards and the creation of state-of-the-art measurement methods provide the wherewithal for the Bureau to provide to the nation (other agencies of the government, state and local governments, universities and other research institutions, industry and commerce) the service upon which all of these entities depend. None of us can afford to take a narrow view in regard to any of the missions of the Bureau. All of us must assure that the research base is available, that the development of standards and methods of measurement are supported, and that the delivery of the Bureau's output is timely and of sufficient quality to meet the needs of its various constituencies. We believe strongly that the National Bureau of Standards should have as its fundamental mission the "custody, maintenance, and development of the national standards of measurement and provision of means and methods for making measurements consistent with those standards, including the comparison of standards used in scientific investigations, engineering, manufacturing, commerce, and educational institutions with those standards adopted or recognized by the Government." This implies that the Bureau should be involved in every activity which leads to the development of standards (documentary or measurement) necessary in the U.S. ecomomy. It also implies the negative: the NBS should not be involved in any activity which is not embodied in that mission. Note that at the present time, we do not believe there is anything going on at the Bureau that is not supportive of that mission although there are known needs in that mission which are not now being met. The Bureau should be designated the "lead agency". for measurement within the Federal Government; it should be funded sufficiently to carry out that responsibility. The current approach of having another agency (such as the DoD) define the measurement problem and - through the funding mechanisms - almost direct the answer is unacceptable. It is also wasteful beceuse it funnels the funds through two "administratives sieves" rather than directly to the Bureau. This recommendation concerns the research and development in measurement. Fully developed services should be provided to other agencies and the public as at present - the application of the standardized fees.

2. Financial and Budgeting

As implied in the preceding, we firmly believe that the research and development necessary for the Bureau to execute its mission is a rightful role of the Federal Government and as also indicated we do not belive this funding should be funneled through other agencies of the Government in order to provide a programmatic base. Exhibit A to this report describes the measurement initiatives that the NCSL considers necessary to bring the NBS back to its rightful place.

The encouragement of widespread use of the outputs of the NBS (information or service) provides a benefit to the American economy as a whole. Consequently, the establishment of user fees should have two thoughts always at the forefront: (1) the fee should not be so high as to discourage necessary wide use and (2) the fee should not be so low as to lead to frivolous use. The fee may be designed to recover all NBS costs incident to the delivery process or only a portion (with the remainder provided by appropriations). The NCSL has supported this concept of "user fees." The costs directly incurred by the Bureau in providing a measurement service should be paid for by those entities which use that service. Research, however, is necessary to advance the frontiers of knowledge of measurement phenomena; but research does not have a predetermined output or answer. It is an investment that must be congressionally appropriated. Even development activities with no clear indication of marketability should also be funded by the appropriations. To the extent that development of a standard or method is directly apparent, i.e., that it is specifically identifiable and the answer is known, some development costs may be able to be recovered from these user fees. To the extent that "user fees" are not so high as to discourage necessary use, it may also be possible to have a surcharge applied, the income from which could be used to develop improvements in existing calibration services or in some selected cases, develop new calibration services. Finally, income could also be derived from royalties from NBS licensing industry to market technology developments made at the Bureau. The "public good" nature of these services contributes in no small way to the competitive edge that America is attempting to recover in science, in industry and in commerce. The investment in the National Bureau of Standards by the Government will significantly contribute to this worthwhile and, we believe, achieveable objective.

EXECUTIVE SUMMARY OF FINANCIAL INITIATIVES

The consideration of dramatically increasing the Congressional Appropriations for the NBS beginning next year will, when enacted , have substantial impact on the competitiveness of American industry almost from the beginning. We have examined the needs of the measurement community, the priority of those needs and an estimate of the cost to meet those needs. The result is summarized at the end of this section; detail on the content of our priorities within the first category is included in Exhibit A.

We have categorized these needs in five areas, all of which have implications for the measurement community, but not all of which are directed at the delivery of the services provided by the NBS. These areas in order of importance are:

1. Infratechnology Services ($34 million)

   This area is, as the ad says, "where the rubber meets the road." It includes the delivery component so necessary to our membership and measurement, in general. Calibration services, standard reference materials, state-of-the-art measurement services are included. So, too, are some information services such as weights and measures offices and support, descriptions of standardized measurement methods, etc. The national standards of chemical, physical and engineering measurements are part of this area.

2. Scientific Knowledge Base ($8.5 million)

   This area includes the fundamental and applied research carried out by NBS scientists in the general area of measuremet phenomena. Together with the fruits of research carried out in universities, this area provides the foundation of knowledge for advances in measurement capability. Such advances in measurement capability (carried out under area 1, above) provide the succeeding research at the NBS and elsewhere to discover more about our physical planet leading to pushing all science frontiers further back.

3. Infratechnology and Market Development ($4.0 million)

   This area is similar to area 1, above, but the focus is more on the generation and publication of documentary standards. Key components in this section are other information services: tables of engineering data and functions, generic product standards, etc.) Writing standards and participating in voluntary standards writing bodies - nationally and internationally - are also important parts.

4. Generic Technology ($5.5 million)

   This area covers the research into various aspects of new or advanced technology. Its outputs are non-proprietary and have as their purpose the creation of the knowledge necessary to apply to specific manufacturing activities.

5. Proprietary Technology ($2.0 million)

   This area includes the usually shared research of industry and NBS in very specific, typically product-related areas. The NBS provides a facility with scientists familiar with the facility's uses and limitations. Industry provides its researchers and some limited funds for carrying out a particular experiment. The results are normally proprietary to the company that is using the facility.

The total of the increases of the above categories is $54M for the basic mission of the NBS. A more detailed description of the needs in the first category is contained in Exhibit A.

Exhibit A
Page 1 of 2

NATIONAL MEASUREMENT REQUIREMENTS
PRIORITY ASSESSMENT

The following listing of national measurement requirements is organized by priority group, A through E (A being highest priority). Within each priority group the parameters are arbitrarily listed by measurement area. The priority assigned for each parameter reflects a broad assessment of the national urgency of the requirement combined with the impact on the nation's industry and defense needs. The groupings were somewhat centered over the priority distribution with none falling in the lowest priority area.

PRIORITY A

MEASUREMENT AREA	PARAMETER
RF-Microwave	Impedance/Admittance
Electro-Optics	Ambient Temperature (Blackbody)
	Laser Power/Energy
	Laser Pointing/Tracking
	Optical Power Meters
Temperature-Pressure	Liquid and Gas Flow
	Pressure
	Temperature
	Vacuum
Physical-Dimensional	Dimensional (Coordinate Measuring Machines)

PRIORITY B

MEASUREMENT AREA	PARAMETER
DC/Low Frequency	AC Voltage
	Capacitance
	DC/LF Ratio
	Magnetic Field Strength
RF-Microwave	Low/High Power
	Noise Temperature
	Attenuation
	Phase Noise
	Antenna Gain
Electro-Optics	Laser Mode Evaluation
	Optical Time Domain Reflectometry
Temperature-Pressure	Electrolytic Conductivity
	Thermal Conductivity
	Vacuum-Leak Rate
Physical-Dimensional	Surface Roughness

Exhibit A
Page 2 of 2

PRIORITY C

MEASUREMENT AREA	PARAMETER
DC/Low Frequency	DC Voltage
	DC/LF Energy/Power
	LF Phase Angle
	DC & AC Resistance
RF-Microwave	Q-Factor
	Power Density
Electro-Optics	Cryogenic Blackbody Calibration
	Detector Spectral Response
	FTRI Spectrophotometry/Photometry Calibration Standards
	IR Window/Filter Transmission
	Laser Beam Profile
	Laser Attenuation
	Optical Fiber Characteristics
	Detector Spectral Response
	Fiber Optic Attenuation
	Optical Fiber Local Area Network
Physical-Dimensional	Flatness (Optical)
	Force
	Gloss
	Hardness Testing
	Haze
	Length (Gage Block)
	Particle Standards

PRIORITY D

MEASUREMENT AREA	PARAMETER
DC/Low Frequency	Inductance
Electro-Optics	Reflectance (Diffuse)
	Reflectance (Specular)
Physical-Dimensional	Hygrometry
	Mass

A-20 MARCH 1987

THE PNMS REPORT

- MICROWAVE METROLOGY IN THE U.S.A.

Prepared By:
THE COMMITTEE TO
PROMOTE NATIONAL MICROWAVE STANDARDS
AN AD HOC COMMITTEE SPONSORED BY
IEEE MICROWAVE THEORY AND TECHNIQUES SOCIETY

PNMS

SECTION 1

20 March 1987

PREFACE

There has been a great deal of concern in the microwave community about the present state of measurement assurance and quality control in the United States. The obvious backbone for reliable measurement assurance is the National Bureau of Standards.

This first edition report from the Committee to Promote National Microwave Standards addresses many of industries' concerns and provides suggestions on how to change the present deteriorating situation.

The report has involved over two years of effort investigating the needs and requirements for the National Bureau of Standards in the microwave business sector. We encourage all readers to use the information gathered to provide further support for the National Bureau of Standards. Our intent is to make this a living document, and we plan updates as the information becomes available.

The committee wishes to thank the many individuals for their tireless efforts in behalf of preparing this report. We intend to improve the future of microwave metrology in the United States.

PNMS POSITION PAPER

INTRODUCTION

There has been a serious and growing atrophy of the resources available to the National Bureau of Standards (NBS) to meet the needs of the Nation in the technology areas of millimeter and microwave test, measurement, calibration and standards. Immediate and energetic efforts must be made to solve severe problems in the near term and to develop adequate size and strength of the NBS microwave resources in the long run. The IEEE/MTTS Committee for the Promotion of National Microwave Standards was formed by concerned industry members to assist the NBS to turn around the present trend. It is the belief of the committee that if the present trend is not dramatically changed, support from NBS will continue to decrease meeting the required needs of government and industry.

PNMS

CRITICAL ISSUES

1. NBS resources for microwave and millimeter programs have declined by a factor of two the past 15 years compared to the microwave and millimeter industry that has more than doubled.

2. Forty percent of the technical staff will be at retirement age the next five years with a bleak outlook of being able to replace them.

3. Other national laboratories have reported better capabilities in the following key areas:

    a. Impedance.
    b. Low and high power.
    c. Attenuation.
    d. Phase shift.
    e. Field Strength.
    f. Antenna Gain.
    g. Noise.

4. Essential measurement services have not been established; for example:

    a. SMA connector, the most used connector in the world.
    b. DOD MILSTAR program for the WR-22 band.

5. Present in-place services are not being updated and improved. Today's technology is demanding better accuracy and capability.

6. Planned NBS funding for the microwave and millimeter programs the next five years falls short of the projected requirements and needs by $7 million per year.

PNMS

IMPACTS

1. Neglect of NBS as a national resource has seriously impacted the microwave defense and communications industry. New systems are left without a method to insure the standardization of processes, and quality has been compromised.

2. Small companies are not financially able to establish metrology laboratories, and are left with a difficult competitive situation.

3. The gap between United States and other countries metrology capabilities is increasing. In fact, industries reliance on these other national laboratories has become essential.

4. Major overseas competition is looming. Lack of adequate support in the basic standards area can impact our worldwide trade position.

5. Conflicts between suppliers and users are on the upswing as the demand for traceable measurements is required for improved quality, producibility, and contractual compliance.

PNMS

RECOMMENDATIONS

1. All concerned at the NBS, DOC, OMB and Congress must insist that the main mission of NBS is establishing, maintaining and disseminating primary standards.

2. Establish a process to continually review the requirements and priorities of the customer base of NBS. We must execute the most important programs first and in a timely fashion.

3. Resources available to the microwave and millimeter programs must be increased to $13 million per year through FY 1991. A sustaining base of $10 million per year is required after the initial rebuilding phase.

4. A strong recruiting program is required to double the present technical staff. Without this program, continued retirement and attrition will sap the remaining strength of the most vital resource the country has in microwave and millimeter metrology.

5. There needs to be a common and highly focused organization structure in NBS to provide for management focus and visibility of key programs and priorities in the microwave and millimeter sector.

6. A short-term plan involving NBS, government, industry, and university seasoned experts should be formed to attack the immediate measurement needs while the long-term program is established.

7. A long term national calibration service that includes:

    a. All national standards reside at NBS.
    b. NBS develop, maintain and provide standards, artifacts and measurement services to industry and other government agencies.
    c. NBS develop accepted methods for stating and demonstrating service capabilities and traceability.
    d. An accepted tiered dissemination system with a program to achieve conformance within each tier.

PNMS Requirements and Priorities Matrix

	Parameter	Coax				Waveguide					
		7 mm	3.5 mm	29 mm	<18 GHz	18-26 GHz	26-40 GHz	33-50 GHz	50-75 GHz	75-110 GHz	>110 GHz
1.	Impedance	A	A		B	A	B	A	C	C	D
2.	Power	A	B		B	B	C	A	D	C	D
3.	Thermal Noise	B	B		B	B	C	A	D	C	D
4.	Attenuation	B	C		C	D	D	B	C	C	F
5.	High Power	C	C		C	E	E	C	G	F	G
6.	Antenna	–	–		E	E	E	C	G	G	H
7.	Power Density	–	–		D	D	F	D	H	G	H
8.	Phase Noise and Switching Speed	–	–		D	F	F	D	H	G	H
9.	Phase	D	G		D	G	G	D	H	H	H

A = Highest Priority

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APPENDIX A

CHARTER

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2. Assist the NBS to identify National requirements and priorities for microwave standards.
3. Assist the NBS to acquire resources with which to carry out their main mission.
4. Assist the NBS to establish a National microwave calibration program.

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APPENDIX B

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APPENDIX C

SUBCOMMITTEES

1. REQUIREMENTS & PRIORITIES:

   a) Identify national requirements and priorities for microwave standards.
   b) Identify current capabilities of NBS and other international services.
   c) Describe current active projects and long range plans of NBS.
   d) Identify, simplify and prioritize needs.
      1) Support NCSL needs.
      2) Support CCG needs.
      3) Support Industry needs.
   e) Organization

   Chairman: Frank K. Koide

   Members: Lou Bowling (CCG Liaison)
   Peter D. Lacy
   Algie L. Lance
   Pat Nolan
   Gunther U. Sorger

2. CALIBRATION PROGRAM:

   a) To assist the NBS to establish a National Microwave Calibration Program.
   b) Organization

   Chairman: Wendell Seal

   Members: Frank K. Koide (NCSL)
   Norm Leck (CCG Liaison)
   Mario A. Maury, Jr.
   C. Miller (NBS Liaison)
   Bruno O. Weinschel

3. MARKET SURVEY:

   a) To determine the size of the microwave industry and projected growth.
   b) Organization

   Chairman: Peter D. Lacy

   Members: Bill Bazzy
   Alan Carlson
   Jud French (NBS Liaison)

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4. NBS ANALYSIS:

   a) Analyze past and present resources of NBS relative to dollars and staff.
   b) Survey International Standards Labs and compare to NBS.
   c) Organization

      Chairman: Bob Powell

      Members: Jud French (NBS Liaison)
      Paul Roberts

5. NBS ACTION PLANS:

   a) To determine what resources NBS is going to need to meet future requirements in terms of dollars and staff.
   b) Develop a plan for NBS to meet these requirements.
   c) Organization

      Chairman: Jerry Hayes

      Members: Del Caldwell (CCG Liaison)
      Jud French (NBS Liaison)
      Algie Lance
      Mario A. Maury, Jr.
      Bob Weber

A-20 MARCH 1987

THE PNMS REPORT

IEEE

MTTS

- MICROWAVE METROLOGY IN THE U.S.A.

Prepared By:
THE COMMITTEE TO
PROMOTE NATIONAL MICROWAVE STANDARDS
AN AD HOC COMMITTEE SPONSORED BY
IEEE MICROWAVE THEORY AND TECHNIQUES SOCIETY

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- MICROWAVE METROLOGY IN THE U.S.A.

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APPENDIXES

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B. PNMS MEMBERSHIP ROSTER
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SECTION 1

20 March 1987

PREFACE

There has been a great deal of concern in the microwave community about the present state of measurement assurance and quality control in the United States. The obvious backbone for reliable measurement assurance is the National Bureau of Standards.

This first edition report from the Committee to Promote National Microwave Standards addresses many of industries' concerns and provides suggestions on how to change the present deteriorating situation.

The report has involved over two years of effort investigating the needs and requirements for the National Bureau of Standards in the microwave business sector. We encourage all readers to use the information gathered to provide further support for the National Bureau of Standards. Our intent is to make this a living document, and we plan updates as the information becomes available.

The committee wishes to thank the many individuals for their tireless efforts in behalf of preparing this report. We intend to improve the future of microwave metrology in the United States.

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SECTION 2 A - 20 March 1987

PNMS POSITION PAPER

INTRODUCTION

There has been a serious and growing atrophy of the resources available to the National Bureau of Standards (NBS) to meet the needs of the Nation in the technology areas of millimeter and microwave test, measurement, calibration and standards. Immediate and energetic efforts must be made to solve severe problems in the near term and to develop adequate size and strength of the NBS microwave resources in the long run. The IEEE/MTTS Committee for the Promotion of National Microwave Standards was formed by concerned industry members to assist the NBS to turn around the present trend. It is the belief of the committee that if the present trend is not dramatically changed, support from NBS will continue to decrease meeting the required needs of government and industry.

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CRITICAL ISSUES

1. NBS resources for microwave and millimeter programs have declined by a factor of two the past 15 years compared to the microwave and millimeter industry that has more than doubled.

2. Forty percent of the technical staff will be at retirement age the next five years with a bleak outlook of being able to replace them.

3. Other national laboratories have reported better capabilities in the following key areas:

    a. Impedance.
    b. Low and high power.
    c. Attenuation.
    d. Phase shift.
    e. Field Strength.
    f. Antenna Gain.
    g. Noise.

4. Essential measurement services have not been established; for example:

    a. SMA connector, the most used connector in the world.
    b. DOD MILSTAR program for the WR-22 band.

5. Present in-place services are not being updated and improved. Today's technology is demanding better accuracy and capability.

6. Planned NBS funding for the microwave and millimeter programs the next five years falls short of the projected requirements and needs by $7 million per year.

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IMPACTS

1. Neglect of NBS as a national resource has seriously impacted the microwave defense and communications industry. New systems are left without a method to insure the standardization of processes, and quality has been compromised.

2. Small companies are not financially able to establish metrology laboratories, and are left with a difficult competitive situation.

3. The gap between United States and other countries metrology capabilities is increasing. In fact, industries reliance on these other national laboratories has become essential.

4. Major overseas competition is looming. Lack of adequate support in the basic standards area can impact our worldwide trade position.

5. Conflicts between suppliers and users are on the upswing as the demand for traceable measurements is required for improved quality, producibility, and contractual compliance.

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RECOMMENDATIONS

1. All concerned at the NBS, DOC, OMB and Congress must insist that the main mission of NBS is establishing, maintaining and disseminating primary standards.

2. Establish a process to continually review the requirements and priorities of the customer base of NBS. We must execute the most important programs first and in a timely fashion.

3. Resources available to the microwave and millimeter programs must be increased to $13 million per year through FY 1991. A sustaining base of $10 million per year is required after the initial rebuilding phase.

4. A strong recruiting program is required to double the present technical staff. Without this program, continued retirement and attrition will sap the remaining strength of the most vital resource the country has in microwave and millimeter metrology.

5. There needs to be a common and highly focused organization structure in NBS to provide for management focus and visibility of key programs and priorities in the microwave and millimeter sector.

6. A short-term plan involving NBS, government, industry, and university seasoned experts should be formed to attack the immediate measurement needs while the long-term program is established.

7. A long term national calibration service that includes:

    a. All national standards reside at NBS.
    b. NBS develop, maintain and provide standards, artifacts and measurement services to industry and other government agencies.
    c. NBS develop accepted methods for stating and demonstrating service capabilities and traceability.
    d. An accepted tiered dissemination system with a program to achieve conformance within each tier.

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SECTION 3

ENDORSEMENTS

ENCLOSED IN THIS SECTION ARE LETTERS FROM INDUSTRY LEADERS THAT SUPPORT "THE PNMS REPORT":

NOTICE
THIS SECTION
WILL BE
ADDED LATER.

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SECTION 4

JUNE 1986

MICROWAVE INDUSTRY SURVEY

BY:

DR. PETER LACY
(CHAIRMAN, PNMS MARKET SURVEY SUB-COMMITTEE)
Chairman of the Board
Wiltron Company
Morgan Hill, California

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THE ECONOMIC AND SOCIETAL IMPACT
OF THE MICROWAVE INDUSTRY

> "...two recent inventions have played a key role in transforming the planet into a global economic village: the jet airplane and the communications satellite.
>
> ...the most important of these is probably the communications satellite. ...Now for the first time, we are truly a global economy, because for the first time we have on the planet instantaneously shared information."
>
> John Naisbitt in MEGATRENDS

Microwave technology provides the national and international web of information transfer for business, government, and personal uses. The volume and safety of air and sea transportation is strongly dependent on microwave radar and navigation aids. Most defense system structures have powerful microwave ingredients. Radio (microwave) astronomy and linear electron accelerators explore the universe and the sub-atomic particle realm. The daily world crises can be viewed on our television screen via microwave satellite links and early medical diagnosis can be made in remote villages of Alaska or Indonesia.

The role of microwave technology can be described in terms of scope and impact, however, its quantitative size is obscured in the larger entities with which it is interlaced. It is estimated to be about one fifth of the dollar volume of all U.S. electronics production. This microwave capability is the key element of our long distance communication, maintains the volume and safety of air transportation and control and supports a majority of current and future military systems.

Satellite relay links utilize microwave transmissions to effect the global communications network. Likewise, microwave radar is used by air traffic controllers to monitor and direct aircraft take offs, landings and flight path allocations. Again radar is used by aircraft pilots to observe other aircraft, mountains, storms and ground markings.

In defense, the electronic battlefield or threat arena has progressed to where tactical and strategic radars plus spectral monitors can be linked by satellite communication links to show situation status for a region or the entire globe. Further, defense weaponry, fire control and projectile guidance largely use microwave systems.

Figure 1 gives a breakdown of the various sectors of the U.S. microwave market. The estimated total for 1985 is 41.0 billion dollars. For further comparisons, this is 19.5% of the estimated 215 billion dollar total electronics market.

Figure 2 shows the distribution various sectors of microwave system production. It emphasizes that the military/government end use predominates with 83%.

Figure 3 tracks the growth of the electronics industry from 1950 to 1985. Then, in Figure 4, the electronic production is shown to be 5.5% of the Gross National Product (GNP). With the microwave segment contributing over 1%.

Next, in Figure 5 the Worldwide Imports, Exports and Trade Balance are shown for the U.S. Electronics Industry from 1979 to 1985. Trade balance has diminished since 1980 and became negative in 1984. The serious segment of trade involving Japan has been negative over the entire interval. Japan is traditionally a poor or vacant market for the communications and defense segments of the U.S. microwave market. Considerable pressure has been exerted to open the communications market access to U.S. trade.

Figure 6 shows that the electronics industries form the largest manufacturing group in the U.S. with more than 2.3 million employees in 1984. The data was compiled by the American Electronics Association (AEA) based on statistics from the U.S. Department of Labor.

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The U.S. has pioneered the application of microwave technology since 1940. Microwave radar was extensively developed by the U.S. during World War II. It became a major factor of the capabilities of the U.S. and their allies. The first terrestrial microwave relay links were instigated in 1947 in the U.S. Then in 1962 the first commercial satellite relay service was established between the U.S. and Europe.

Efficient and cost effective manufacture is dependent on "The technique of interchangeable part manufacture" as propounded by Eli Whitney in 1800. Measurement accuracy determines parts interchangeability, as well as overall system performance. With the proud U.S. background in the origination of microwave applications, it behooves us to maintain standards at the highest level. This precision is necessary to produce and maintain quality products and systems at competitive prices in a world economy where the competition of suppliers is wide spread and the demand world wide.

The Organic Act of the National Bureau of Standards authorizes NBS to undertake the following functions:

> The custody, maintenance, and development of the national standards of measurement, and the provision of means and methods for making measurements consistent with those standards, including the comparison of standards used in scientific investigations, engineering, manufacturing, commerce, and educational institutions, with the standards adopted or recognized by the Government.

It is, herewith, strongly argued that the above underlined functions are necessary and essential. Further that they should have priority over other authorized functions for NBS that involve applied research and fundamental scientific studies. It is the above stated custody of national standards that cannot be transferred or delegated in order to maintain U.S. creditability among other nations.

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U.S. Microwave Production 1985*

(in $ millions)

Systems:	
Military / Government	25,520
Commercial Communications	3,190
" Navagation / Industrial	1,370
Consumer	957
Total Systems	31,037
Components:	
Internal System	4,027
Antennas	3,509
Total Components	7,536
Test Equipment:	
Catalog	1,186
Automatic (ATE)	1,300**
	2,486
TOTAL:	41,092

*Estimate by Electronicast **Line Item by Carlson, MA Comm

Figure 1

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Microwave System Production 1985

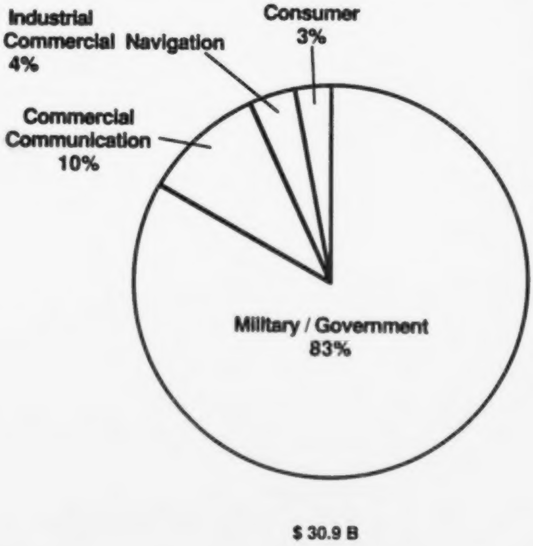

Figure 2

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U.S. Electronic Production*

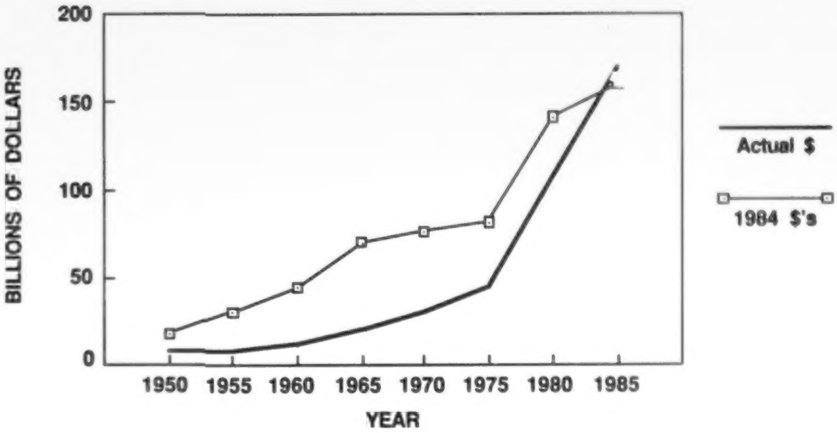

Figure 3

*E.I.A. Data

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U.S. Production of Electronic Equipment and the GNP

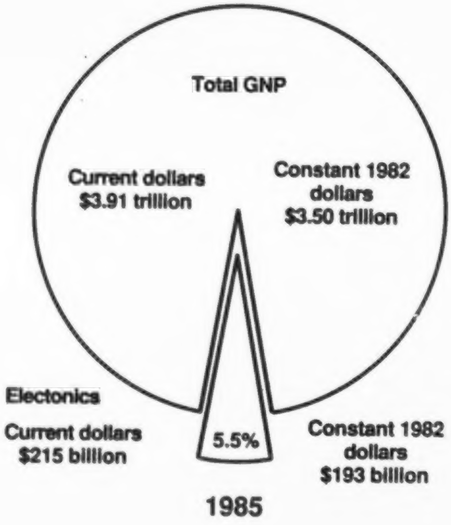

Figure 4

Source: Gnostic Concepts, Inc.

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U.S. Electronics Trade Balance

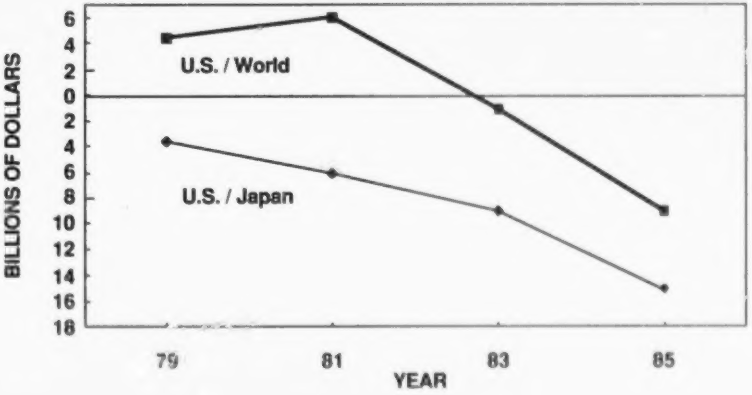

Figure 5

U.S. Department of Commerce

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Employment in Manufacturing Industries

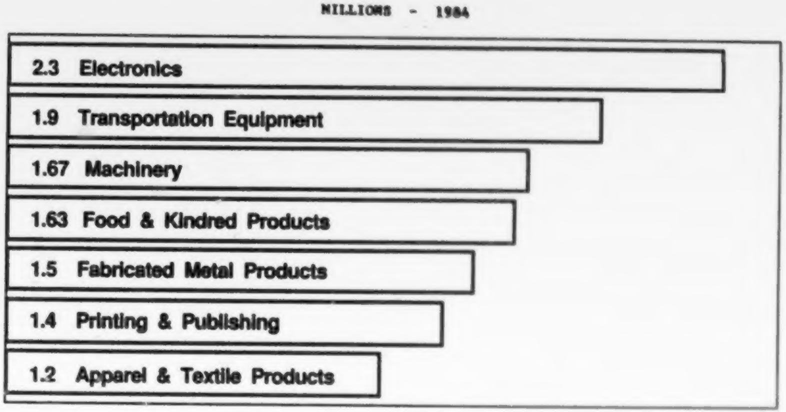

Figure 6

AEA/U.S. Dept. of Labor

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SECTION 5 JUNE 1986

ANALYSIS OF THE NATIONAL BUREAU OF STANDARDS (NBS)

BY:

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NATIONAL BUREAU OF STANDARDS ANALYSIS

The objectives of this section are: to outline the National Bureau of Standards Organization showing the units responsible for Radio Frequency and Microwave Standards and Measurements; to analyze present and past resources provided to the responsible units; to compare current capabilities of NBS with the capabilities of other national laboratories; and to describe current and planned NBS activities for microwave measurements and standards.

Figure 1 shows the organizational location of the two divisions primarily responsible for radio and microwave measurements, the Electromagnetic Technology and Fields Divisions which are physically located in Boulder, Colorado. There are two other divisions under the Center for Electronics and Electrical Engineering. These are concerned with semiconductor materials and devices and with electro systems. Likewise there are five other centers under the National Engineering Laboratory covering mathematical, chemical, building, fire and manufacturing engineering. Time and frequency work is located in the National Measurement Laboratory.

The funding for the Electromagnetic Fields and Technology Divisions for Fiscal Year 1983 is shown in Figure 2. This data is from year-end accounting tables. About 48% of the funding came directly from the NBS appropriation, 46% was transferred from appropriations of other federal agencies and 6% came from fees charged for calibration services.

Figure 3 shows the history of this funding over the last 15 years normalized to 1982 dollars. This data is from year end accounting records, personnel lists and project records. All of these records were not available for each year, but ratios of number of people to normalized funds expended remained fairly constant enabling interpolation. This figure shows that total funding and funds from the NBS appropriation remained relatively constant, but increasing work for other agencies was offset by a nearly steady decline of calibrations, from nearly $3 million per year to less than $1 million per year over the past 15 years.

Figure 4 gives the history of the number of people involved. The total for each year is separated into those primarily concerned with standards and measurements and those concerned with related research. Separation was done by review of project descriptions and organizational unit objectives. It is significant that the number of people concerned directly with radio and microwave standards dropped rapidly during the 1960's and leveled out at the end of the 1970's with less than half of the staff found at the beginning of that decade.

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4. Assist the NBS to establish a National microwave calibration program.

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APPENDIX C

SUBCOMMITTEES

1. REQUIREMENTS & PRIORITIES:
   - a) Identify national requirements and priorities for microwave standards.
   - b) Identify current capabilities of NBS and other international services.
   - c) Describe current active projects and long range plans of NBS.
   - d) Identify, simplify and prioritize needs.
     - 1) Support NCSL needs.
     - 2) Support CCG needs.
     - 3) Support Industry needs.
   - e) Organization

     Chairman: Frank K. Koide

     Members: Lou Bowling (CCG Liaison)
     Peter D. Lacy
     Algie L. Lance
     Pat Nolan
     Gunther U. Sorger

2. CALIBRATION PROGRAM:
   - a) To assist the NBS to establish a National Microwave Calibration Program.
   - b) Organization

     Chairman: Wendell Seal

     Members: Frank K. Koide (NCSL)
     Norm Leck (CCG Liaison)
     Mario A. Maury, Jr.
     C. Miller (NBS Liaison)
     Bruno O. Weinschel

3. MARKET SURVEY:
   - a) To determine the size of the microwave industry and projected growth.
   - b) Organization

     Chairman: Peter D. Lacy

     Members: Bill Bazzy
     Alan Carlson
     Jud French (NBS Liaison)

4. **NBS ANALYSIS:**

   a) Analyze past and present resources of NBS relative to dollars and staff.
   b) Survey International Standards Labs and compare to NBS.
   c) Organization

      Chairman: Bob Powell

      Members: Jud French (NBS Liaison)
      Paul Roberts

5. **NBS ACTION PLANS:**

   a) To determine what resources NBS is going to need to meet future requirements in terms of dollars and staff.
   b) Develop a plan for NBS to meet these requirements.
   c) Organization

      Chairman: Jerry Hayes

      Members: Del Caldwell (CCG Liaison)
      Jud French (NBS Liaison)
      Algie Lance
      Mario A. Maury, Jr.
      Bob Weber

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The remaining figures graphically show the NBS services available and compare these with services from other National Laboratories, with approximate services required, and with a rough approximation of accuracy limits based on physical constraints. Various lists and schedules of these service accuracies and ranges were collected, but the most comprehensive list was the August 1984 draft of "URSI Register of National Standards Laboratories" prepared for the Union Radio-Scientifique International by a working group chaired by Mr. A. E. Bailey. The data from this report, as given in the accompanying table, was used except for known subsequent revisions such as in microwave horn gain, and additional data available such as services available in China. To simplify the charts all of the data was not plotted. Only the best accuracies reported and NBS accuracy reported are shown. Where insufficient data of accuracy and frequency was available, the data was plotted approximately parallel to physical constraint limits. All national laboratories do not calculate and report uncertainties in the same manner so detailed conclusions should not be drawn. However, it is clear that there is a metrological gap to be closed before the National Bureau of Standards can achieve and sustain international leadership.

Various plans for future work by NBS were reviewed. Implementation of these plans depends upon resources available and priorities, therefore, the plans must be changed from time to time.

Attenuation and impedance services including those for reflection coefficient and network parameters will depend upon current efforts to extend the use of six-ports from 100 KHz to 100 GHz and higher frequencies if required. This could provide resolution in attenuation ranging from 0.001 dB/20 dB to 1 dB/80 dB and resolution in phase ranging from 0.01° at 20 dB to 10° at 80 dB. Resolution of reflection coefficient would be 2.10^{-5} in magnitude and $0.001°/\Gamma$ for phase angle. Uncertainty would depend upon resolution and accuracy of transmission line standards used to calibrate the systems and repeatability of the connectors. Calibration of IF attenuation will be improved by introduction of service at 1.25 MHz for 6 dB steps. The uncertainty should be less than 6 μB for insertion loss less than 20 dB. There are no immediate plans to extend this service to 30 MHz and other frequencies.

There are no plans to improve power services due to lack of resources except for improvement of VSWR measurements and calibration of range extending couplers using the 6-ports.

There are no plans for modulation service due to priority and resources.

Extension of noise measurement services to other frequencies depends upon availability of resources.

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There are no plans to extend field-strength services for electromagnetic interference and susceptibility. It is planned to extend power density measurements to other frequencies depending upon resources and safety requirements.

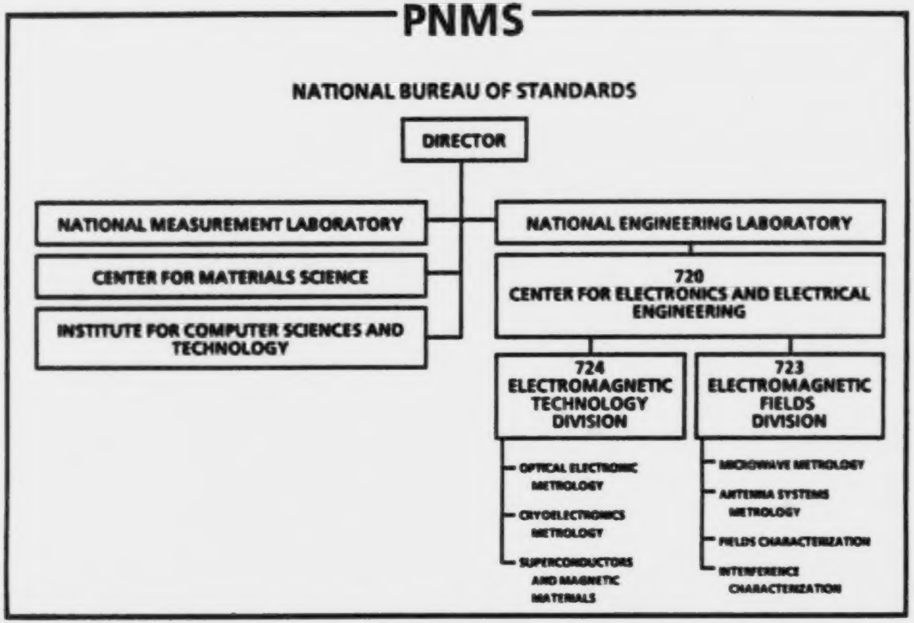
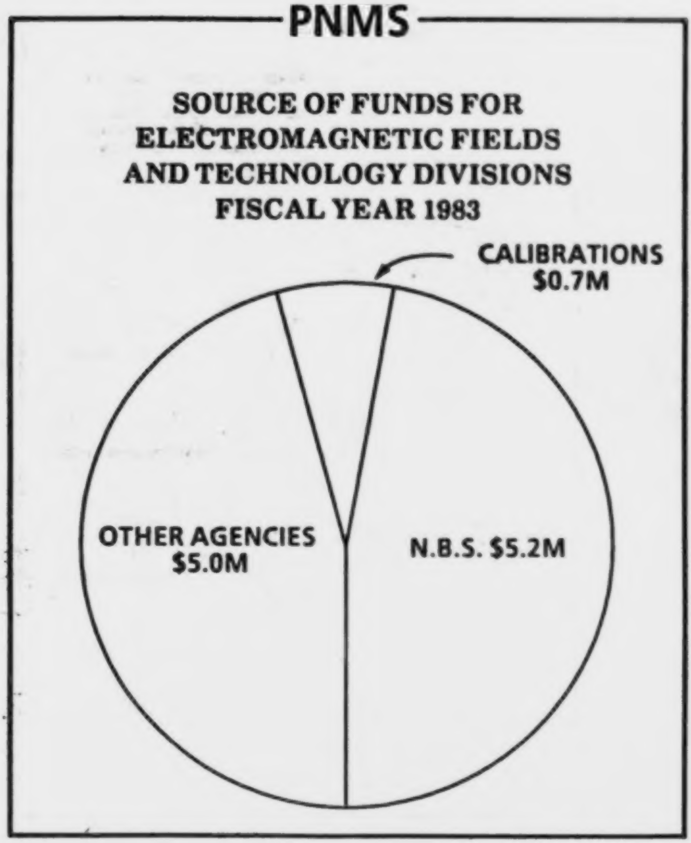

PNMS
NATIONAL BUREAU OF STANDARDS
DIRECTOR
NATIONAL MEASUREMENT LABORATORY
CENTER FOR MATERIALS SCIENCE
INSTITUTE FOR COMPUTER SCIENCES AND TECHNOLOGY
NATIONAL ENGINEERING LABORATORY
720 CENTER FOR ELECTRONICS AND ELECTRICAL ENGINEERING
724 ELECTROMAGNETIC TECHNOLOGY DIVISION
723 ELECTROMAGNETIC FIELDS DIVISION
OPTICAL ELECTRONIC METROLOGY
CRYOELECTRONICS METROLOGY
SUPERCONDUCTORS AND MAGNETIC MATERIALS
MICROWAVE METROLOGY
ANTENNA SYSTEMS METROLOGY
FIELDS CHARACTERIZATION
INTERFERENCE CHARACTERIZATION

FIGURE 1

933



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SOURCE OF FUNDS FOR ELECTROMAGNETIC FIELDS AND TECHNOLOGY DIVISIONS FISCAL YEAR 1983

FIGURE 2

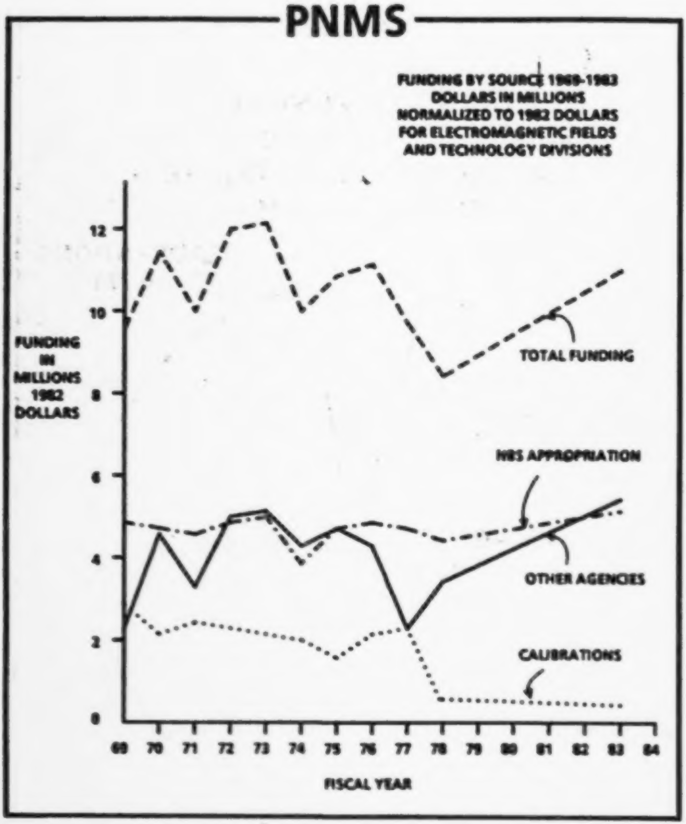
PNMS
FUNDING BY SOURCE 1969-1983
DOLLARS IN MILLIONS
NORMALIZED TO 1982 DOLLARS
FOR ELECTROMAGNETIC FIELDS
AND TECHNOLOGY DIVISIONS
FUNDING IN MILLIONS 1982 DOLLARS
0
2
4
6
8
10
12
TOTAL FUNDING
NBS APPROPRIATION
OTHER AGENCIES
CALIBRATIONS
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
FISCAL YEAR

FIGURE 3

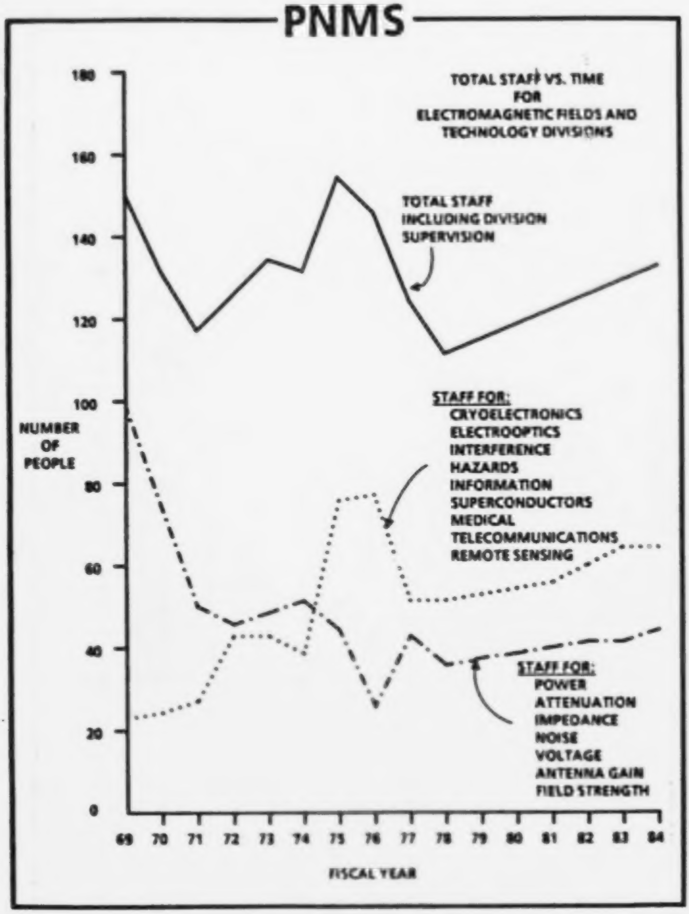
PNMS
TOTAL STAFF VS. TIME
FOR
ELECTROMAGNETIC FIELDS AND
TECHNOLOGY DIVISIONS
TOTAL STAFF
INCLUDING DIVISION
SUPERVISION
STAFF FOR:
CRYOELECTRONICS
ELECTROOPTICS
INTERFERENCE
HAZARDS
INFORMATION
SUPERCONDUCTORS
MEDICAL
TELECOMMUNICATIONS
REMOTE SENSING
STAFF FOR:
POWER
ATTENUATION
IMPEDANCE
NOISE
VOLTAGE
ANTENNA GAIN
FIELD STRENGTH
NUMBER
OF
PEOPLE
180
160
140
120
100
80
60
40
20
0
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
FISCAL YEAR

FIGURE 4

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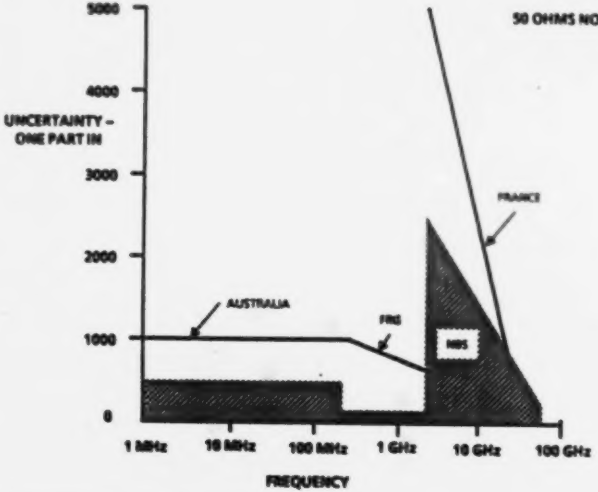
NBS ACCURACY AND WORLD BEST ACCURACY
VS. FREQUENCY
FOR
IMPEDANCE

50 OHMS NOMINAL



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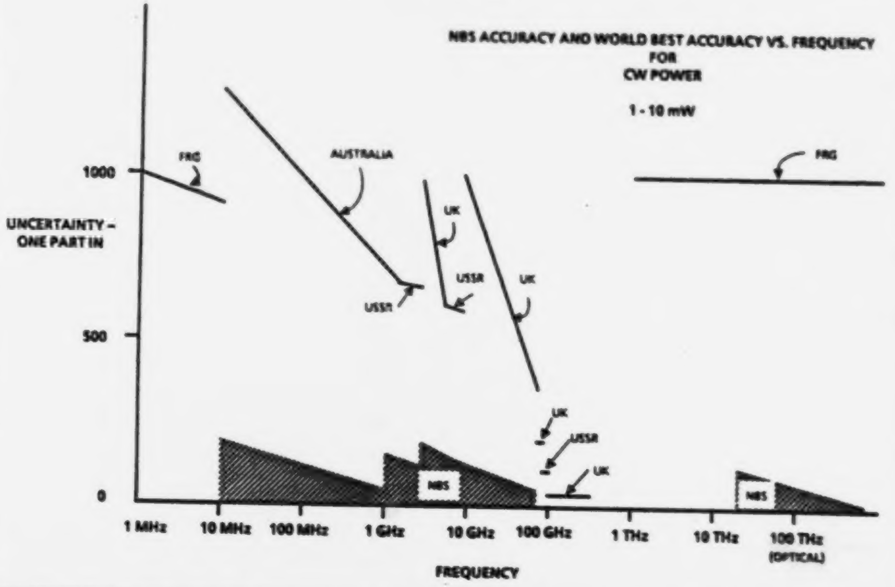
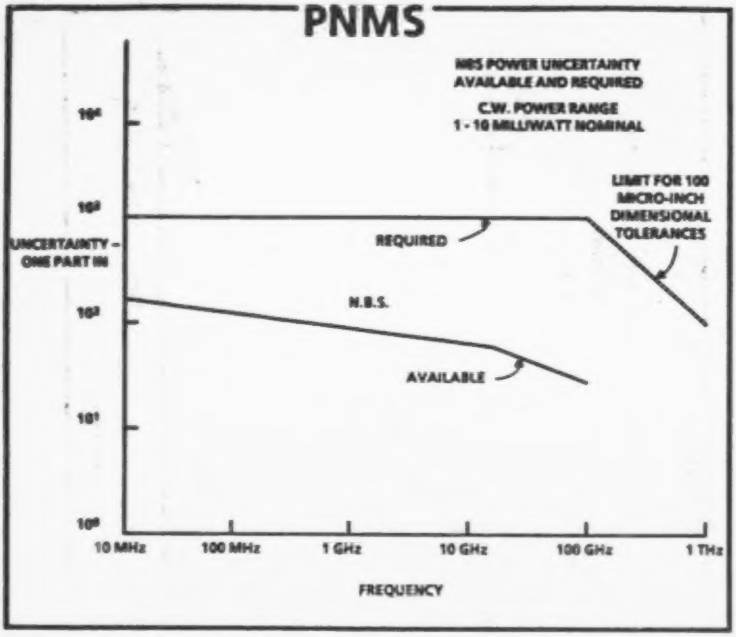


NBS ACCURACY AND WORLD BEST ACCURACY VS. FREQUENCY
FOR
CW POWER

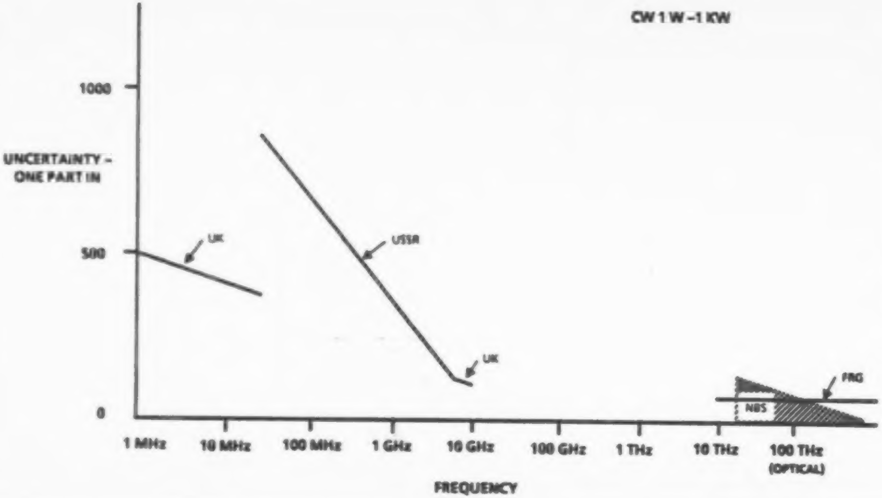
1 - 10 mW


PNMS
NBS POWER UNCERTAINTY
AVAILABLE AND REQUIRED
C.W. POWER RANGE
1 - 10 MILLIWATT NOMINAL
LIMIT FOR 100 MICRO-INCH DIMENSIONAL TOLERANCES
REQUIRED
N.B.S.
AVAILABLE
UNCERTAINTY – ONE PART IN
10⁴
10³
10²
10¹
10⁰
10 MHz
100 MHz
1 GHz
10 GHz
100 GHz
1 THz
FREQUENCY

PNMS

NBS ACCURACY AND WORLD BEST ACCURACY
VS. FREQUENCY
FOR
HIGH POWER

CW 1 W – 1 KW



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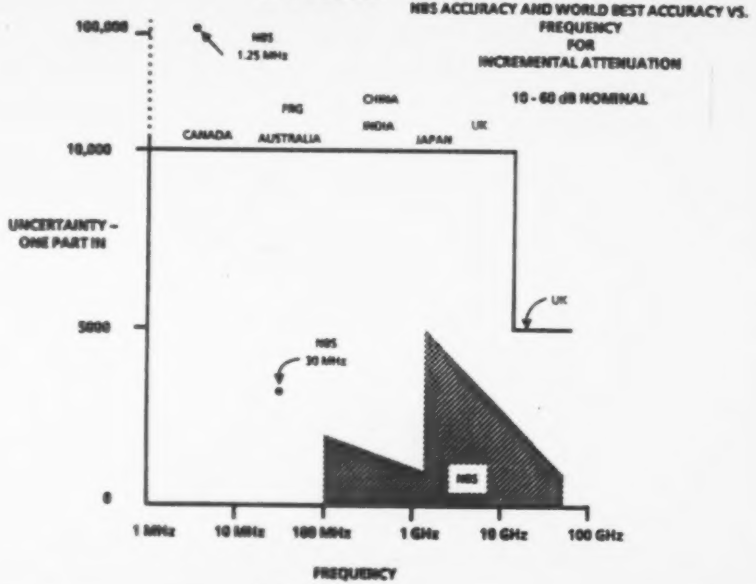
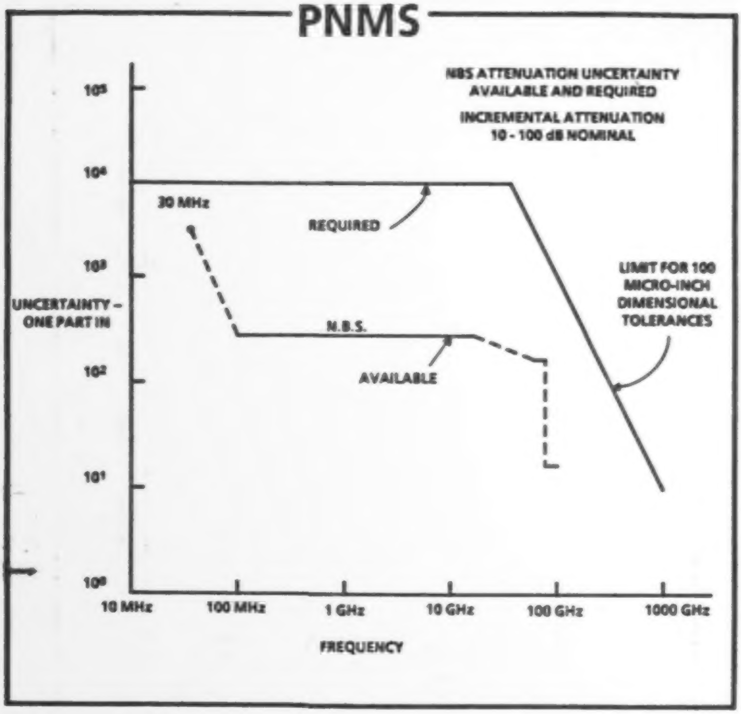


NBS ACCURACY AND WORLD BEST ACCURACY VS.
FREQUENCY
FOR
INCREMENTAL ATTENUATION

10 - 60 dB NOMINAL


PNMS
NBS ATTENUATION UNCERTAINTY AVAILABLE AND REQUIRED
INCREMENTAL ATTENUATION 10 - 100 dB NOMINAL
10^5
10^4
10^3
10^2
10^1
10^0
UNCERTAINTY – ONE PART IN
30 MHz
REQUIRED
N.B.S.
AVAILABLE
LIMIT FOR 100 MICRO-INCH DIMENSIONAL TOLERANCES
10 MHz
100 MHz
1 GHz
10 GHz
100 GHz
1000 GHz
FREQUENCY

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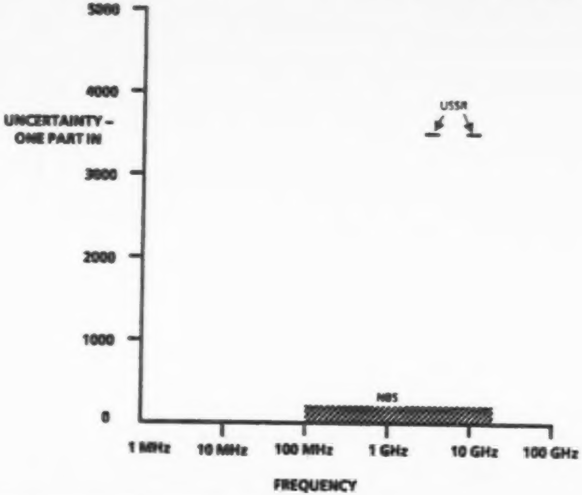
NBS ACCURACY AND WORLD BEST ACCURACY
VS. FREQUENCY
FOR
INCREMENTAL PHASE SHIFT



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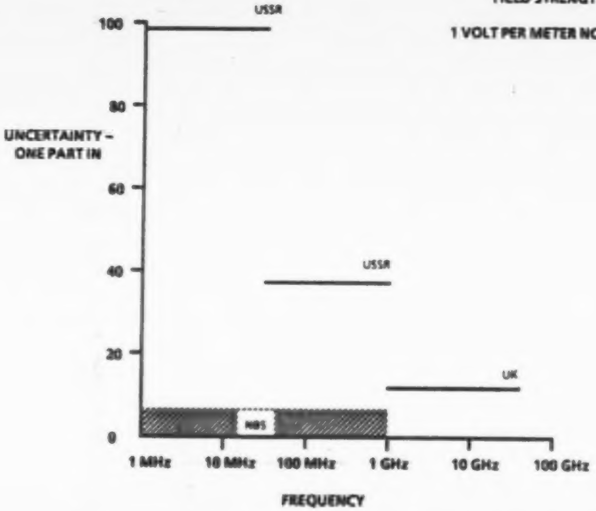
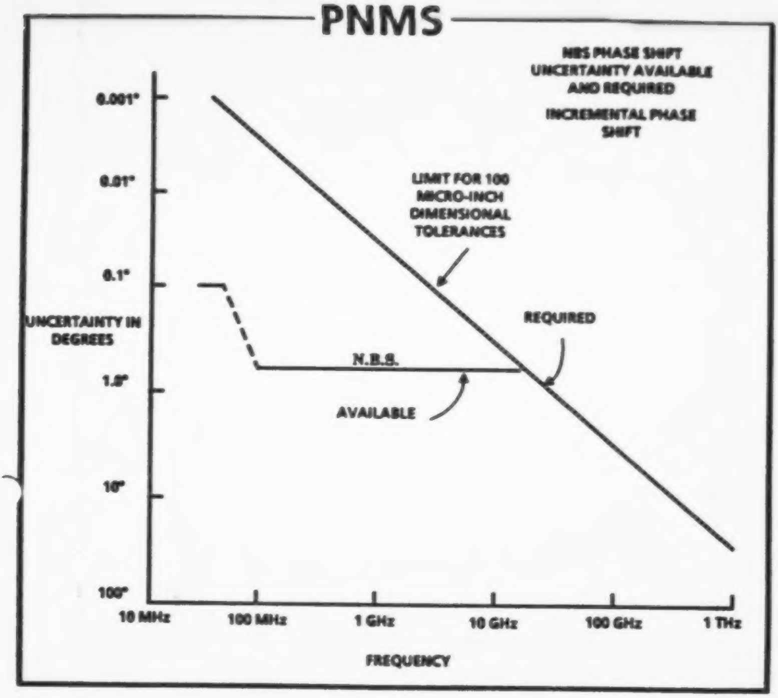
NBS ACCURACY AND WORLD BEST ACCURACY
VS. FREQUENCY
FOR
FIELD STRENGTH

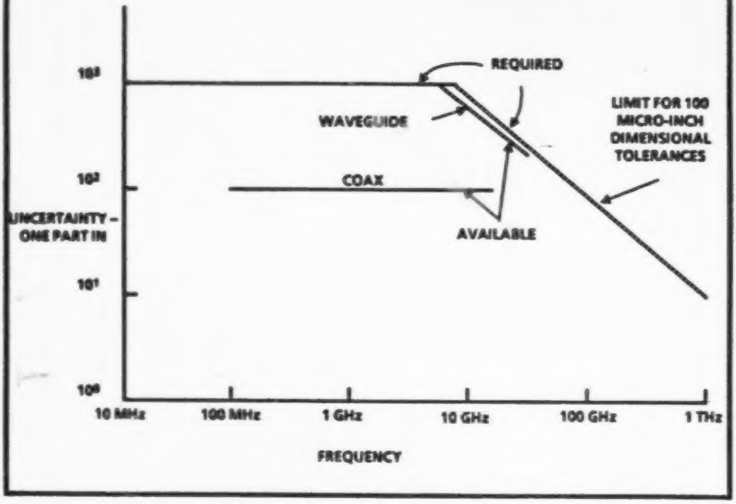
1 VOLT PER METER NOMINAL




PNMS
NBS PHASE SHIFT UNCERTAINTY AVAILABLE AND REQUIRED
INCREMENTAL PHASE SHIFT
LIMIT FOR 100 MICRO-INCH DIMENSIONAL TOLERANCES
REQUIRED
N.B.S.
AVAILABLE
UNCERTAINTY IN DEGREES
0.001°
0.01°
0.1°
1.0°
10°
100°
10 MHz
100 MHz
1 GHz
10 GHz
100 GHz
1 THz
FREQUENCY

PNMS

NBS IMPEDANCE
AND REQUIRED



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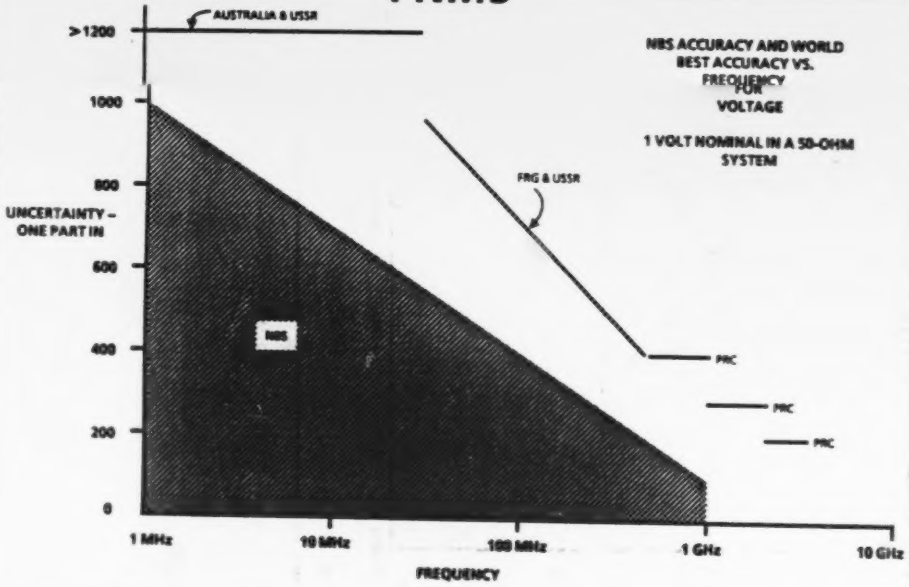

NBS ACCURACY AND WORLD
BEST ACCURACY VS.
FREQUENCY
FOR
VOLTAGE

1 VOLT NOMINAL IN A 50-OHM
SYSTEM

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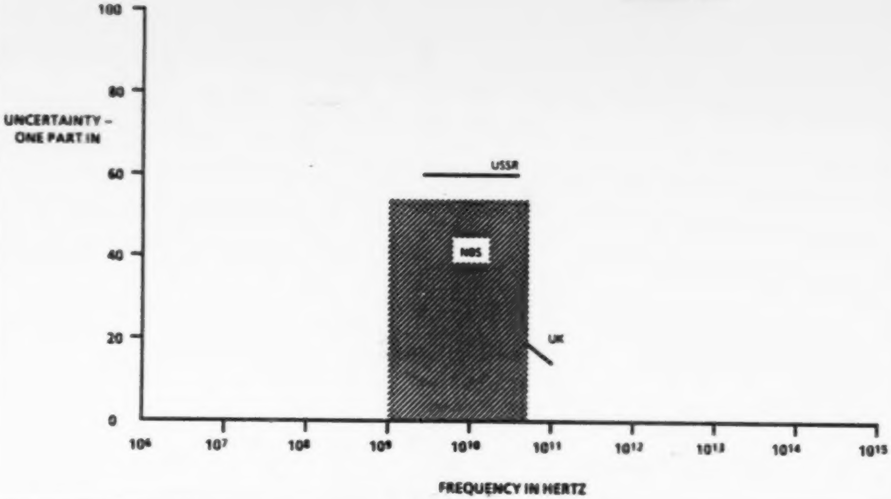
NBS ACCURACY AND WORLD BEST ACCURACY
VS. FREQUENCY
FOR
ANTENNA GAIN



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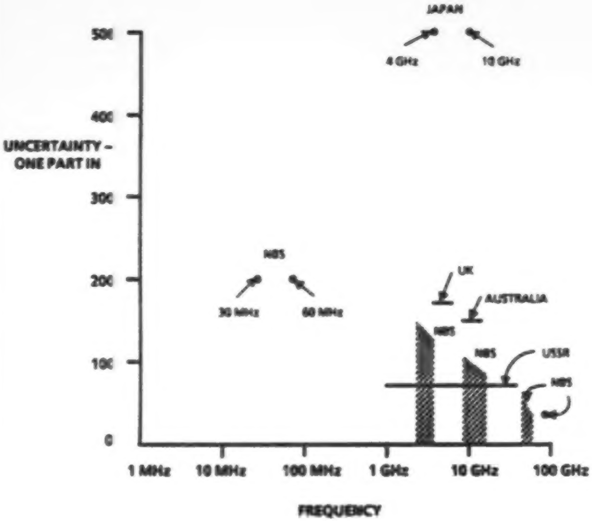
ACCURACY VS. FREQUENCY
FOR
NOISE



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SECTION 6

MARCH 1986

REQUIREMENTS & PRIORITIES ANALYSIS

BY:

FRANK K. KOIDE
(CHAIRMAN, REQUIREMENTS & PRIORITIES SUB-COMMITTEE)
President
Koide International Consultants
La Jolla, California

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SUMMARY

The objectives of the PNMS SubCommittee is to develop the Requirements and Priorities Matrix from inputs provided from NCSL, Calibration Coordination Group (CCG) of the Military Tri-Services Metrology Laboratories, and PNMS.

This report describes the new measurement requirement needs from industry and the military tri-services in the millimeter wave area.

The Matrix Requirements and Priorities Charts recommends 75 Group Priorities. Each letter represent a Group where A being the highest priority. The high lighted letters in the matrix represent areas in which NBS provides limited or no calibration services at all. The matrix also indicates there are no NBS services from 3.5 mm (SMA) connectors where instrumentation and standards are now available to 26.5GHz. The trend is to develop connectors well into the 40GHz region for program such as MILSTAR and Weapons Guidance Systems.

The prime concern is placed on WR-22 (33GHz-50GHz) waveguide band for MILSTAR where the NBS does not provide calibration services. These services include Impedance, Power, Attenuation, Thermal Noise,Antenna Gain, and Phase Noise. The two latter parameters of antenna gain and phase noise are not the traditional Metrology calibration requirements, but will have a major impact in the MILSTAR program as they are most critical in the operational system mode.

In the industrial sectors, high reliability connectors are prominent for the Telecommunication (Business Radio Systems) data transmission systems. Both Type N and SMA type connectors are used for frequencies to 18 GHz and 24 GHz respectively.

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MEASUREMENT SERVICE DEFICIENCIES

The eight Measurement Service Deficiencies charts indicates the Requirements and Priorities for the different parameters associated with the coaxial/waveguide bands,range/accuracies where NBS services are required. These charts also indicate the programs being supported.

Impedance

Impedance being fundamental to all measurements, it has the highest priority among the eight measurement service deficiencies charts. Both Standards and System Grade groupings are required. The Standards Grade includes the traditional 7mm(GPC-7) and the 3.5mm(GPL-3.5) connectors primarily for industry and Tri-Service Standards. The System Grade are required for the operational system level. These connectors includes the Type N and TNC. The TNC connectors are primarily used in antenna systems for space vehicles such as GPS and the Space Shuttle as they have a history of high reliability and can withstand the temperature extreme of the space environment. The TNC will be a standard for the space programs. In the waveguide bands, Impedance is required for all programs from MILSTAR at 44GHz to the Radar Guidance and Passive Systems in the 94 GHz region.

Power

Similar to Impedance, Power is also a fundamental parameter. Power measurements are required for both 10mW standard level to the high power level of at least 160 Watts for MILSTAR in the WR-22 waveguide band. Improved accuracies are required for both coaxial connectors to 26.5GHz and waveguide bands to 110GHz for communication and Short Range Radars and Seekers.

Attenuation

Although, Attenuation is not a fundamental parameter, it is one of the most critical parameter in millimeter wave measurements. The range and accuracy requires several orders of magnitude improvement. These accuracy and dynamic range requirements are critical for not only industry and Tri-Service standards, but GPS, Trident, MILSTAR, Guidance and Passive Systems as well as the many classified programs.

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Thermal Noise

The NBS services are nonexistent in the 3.5mm connector and waveguide bands of WR-42(18GHz-26.5GHz), WR-28(26.5GHz-40GHz),and WR-22(33GHz-50GHz) as compared to the other measurement parameters and are the most difficult to develop fundamental standards. Thermal Noise standards are most critical to all receiver systems for MILSTAR and Communication/Radar systems,primarily for satellite applications.

Fields and Antennas

Unlike power,impedance, attenuation,thermal noise, antenna gain measurement has recently surfaced as a major Metrology calibration requirement due to satellite, communication/radar system programs. MILSTAR is a prime example, where not only the boresight gain must be calibrated, but polarization and pattern measurements are required.

Power Density

Power Density measurements are required to 26.5GHz at levels up to 100mW/cm^{2}for OSHA regulation, Radar System, and EMI regulation on ships as well as the Tri-Services and industry requirements. The NBS has limited capabilities to 1GHz at 10mW/cm^2.

Phase

Similar to Impedance, phase measurements are required for antenna gimble assemblies and receiver systems on Radars for F-111, GPS, Space Shuttle, Trident,MILSTAR,and Communication systems. NBS does not have calibration services for the 3.5mm connectors.

Phase Noise and Switching Speed

A non-traditional area of major concern which recently surfaced as a result of the next generation of military communication and navigation program. Phase Noise and Switching Speed is required for the MILSTAR Program for both Payload and Terminal/Airborne Systems. No formal calibration services are available at the NBS. A partial capability exist on a case bases at the Time and Frequency Division of the Boulder Laboratories.

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REQUIREMENTS AND PRIORITIES SUBCOMMITTEE MEMBERS

• FRANK K. KOIDE, CHAIRMAN	ROCKWELL INTERNATIONAL
• DR. GUNTER U. SORGER	EATON
• ALGIE LANCE	TRW
• DR. PETER LACY	WILTRON
• PATRICK NOLAN	LOCKHEED MISSILE AND SPACE
LIAISON	
• LOU BOWLING	U.S. ARMY TMDE SUPPORT GROUP
• RICK PATINO	U.S. NAVY METROLOGY ENG CENTER

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REQUIREMENTS AND PRIORITIES OBJECTIVES

- IDENTIFY NATIONAL REQUIREMENTS AND PRIORITIES FOR MICROWAVE STANDARDS
- IDENTIFY, SIMPLIFY AND PRIORITIZE NEEDS
  - SUPPORT NCSL NEEDS
  - SUPPORT CCG NEEDS
  - SUPPORT INDUSTRY NEEDS

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RECOMMENDATION REQUIREMENTS AND PRIORITIES MATRIX

PARAMETER	FREQUENCY	COAXIAL		WAVEGUIDE						
		<18GHz 7 mm	<26 GHz 3.5 mm	< 18 GHz	18-26 GHz	26-40 GHz	33-50 GHz	50-75 GHz	75-110 GHz	> 110 GHz
1	IMPEDANCE	A	A	B	A	B	A	C	C	D
2	POWER	A	B	B	B	C	A	D	C	D
3	THERMAL NOISE	B	B	B	B	B	B	D	D	F
4	ATTENUATION	B	C	C	D	D	B	C	C	F
5	HIGH POWER	C	C	C	E	E	C	G	F	G
6	ANTENNA	–	–	E	E	E	C	G	G	H
7	POWER DENSITY	–	–	D	D	F	D	H	G	H
8	FREQUENCY (PHASE NOISE AND SWITCHING SPEED)	–	–	D	F	F	D	H	G	H
9	PHASE	D	G	D	G	G	D	H	H	H

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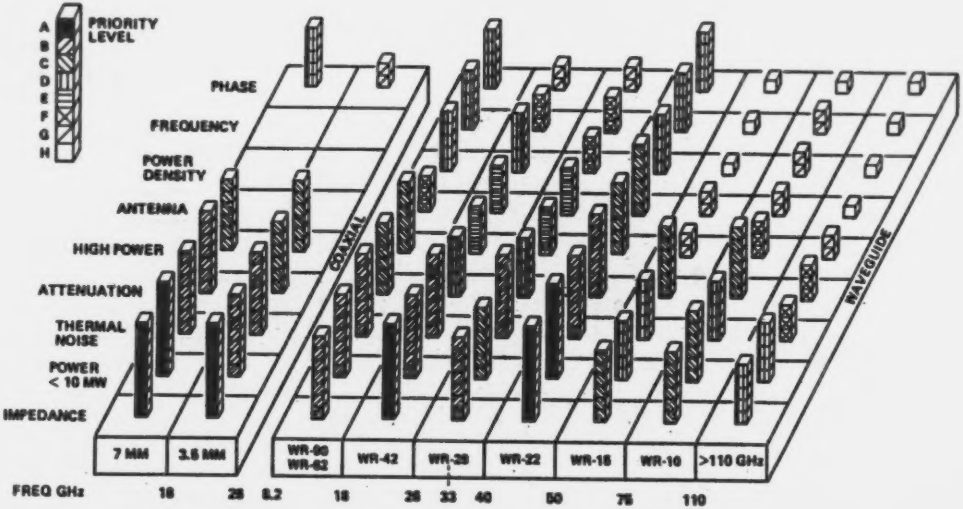
RECOMMENDATION
REQUIREMENTS AND PRIORITIES SUMMARY



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MEASUREMENT SERVICE DEFICIENCIES
IMPEDANCE (REFLECTION COEFFICIENT)

PRIORITY	COAX/W.G. BAND	RANGE/ACCURACY	NBS SERVICE	PROGRAMS
	STANDARDS GRADE			
A	7 mm (GPC-7) (0.01 TO 18 GHz)	0.01 TO 0.8 ±(0.001 TO 0.01)	±(0.005 TO 0.01)	INDUSTRY AND TRI-SERVICE STANDARDS
A	3.5 mm (GPC-3.5) (0.01 TO 26 GHz)	0.01 TO 0.8 ± (0.002 TO 0.01) IEC PUB 457-5 1984	NONE	GPS, SPACE SHUTTLE, TRIDENT, F-111, SPECIAL PROGRAMS
	SYSTEMS GRADE			
A	TYPE N (0.01 TO 18 GHz)	0.01 TO 0.8 ± (0.002 TO 0.02)	NEED PLANS	GPS, TRIDENT, SPECIAL PROGRAMS
A	TNC (0.01 TO 18 GHz)	0.01 TO 0.8 ±(0.005 TO 0.02)	NEED PLANS	
	SMA (0.01 TO 26.5 GHz)	0.01 TO 0.8 ± (0.003 TO 0.03)	NEED PLANS	
A	WR-22 (33 TO 50 GHz)	0.002 TO 0.33 ± (0.001 TO 0.005)	NONE	MILSTAR
C	WR-15 (50 TO 75 GHz)	SAME AS ABOVE	NONE	SPECIAL PROGRAMS
C	WR-10 (75 TO 110 GHz)	0.002 TO 0.33 ± (0.005 TO 0.01)	LIMITED SERVICE 94-96 GHz	SHORT RANGE RADAR, GUIDANCE AND PASSIVE SYSTEMS

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MEASUREMENT SERVICE DEFICIENCIES
POWER

PRIORITY	COAX/W.G. BAND	RANGE/ACCURACY	NBS SERVICE	PROGRAMS
A	7 mm (GPC-7) (0.01 TO 18 GHz)	1 mW TO 10 mW ±(0.5 TO 0.3)%	SERVICE AT 10 mW ONLY	INDUSTRY STANDARDS
B	3.5 mm (GPC-3.5) (0.01 TO 26.5 GHz)	0.1 TO 100 mW ± (0.5 TO 2.0)%	NONE	GPS, TRIDENT, F-111, MMIC, COMMUNICATION SYSTEMS
A	TYPE N (0.01 TO 18 GHz)	1 mW TO 10 mW ± (0.5 TO 5)%	SERVICE AT 10 mW ONLY	GPS, TRIDENT, COMMUNICATION SYSTEMS
A	WR-22 (33 TO 50 GHz)	1 TO 100 mW ±1%	NONE	MILSTAR
D	WR-15 (50 TO 75 GHz)	1 TO 100 mW ± (1 TO 2)%	SERVICE AT 10 mW ONLY	SPECIAL PROGRAMS
C	WR-10 (75 TO 110 GHz)	1 TO 100 mW ± (2 TO 3)%	SERVICE AT 10 mW AT 94-96 GHz	SHORT RANGE RADAR, GUIDANCE AND PASSIVE SYSTEMS

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MEASUREMENT SERVICE DEFICIENCIES
THERMAL NOISE

PRIORITY	COAX/W.G. BAND	RANGE/ACCURACY	NBS SERVICE	PROGRAMS
B	TYPE N (0.01 TO 18 GHz)	4 TO 30 dB ENR ± (0.05 TO 0.2 dB)	SELECTED FREQUENIES	INDUSTRY AND TRI-SERVICE STANDARDS, GPS, TRIDENT
B	3.5 mm (0.01 TO 26.5 GHz)	12 TO 18 dB ENR ± (0.05 TO 0.2) dB	NONE	INDUSTRY AND TRI-SERVICE STANDARDS, MMIC
B	WR-42 (18 TO 26.5 GHz)	15 TO 17 dB ENR ± 0.1 dB	NONE	MILSTAR
B	WR-28 (26.5 TO 40 GHz)	SAME AS ABOVE	NONE	WEAPONS GUIDANCE SYSTEM
B	WR-22 (33 TO 50 GHz)	SAME AS ABOVE	NONE	MILSTAR

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MEASUREMENT SERVICE DEFICIENCIES ATTENUATION

PRIORITY	COAX/W.G. BAND	RANGE/ACCURACY	NBS SERVICE	PROGRAMS
B	7 mm (GPC-7) (0.01 TO 18 GHz)	0 TO 60 dB ± (0.005 TO 0.10) dB	±0.03 dB/10 dB 10 dB	INDUSTRY AND TRI-SERVICE STANDARD
C	3.5 mm (GPL-3.5) (0.01 TO 26.5 GHz)	0 TO 60 dB ± (0.01 TO 0.1) dB	NONE	TRIDENT, GPS, SPACE SHUTTLE, F-111
B	TYPE N (0.01 TO 18 GHz)	0 TO 60 dB ± 0.005 dB TO 0.1) dB	± 0.03 dB/ 10 dB	
B	WR-22 (33 TO 50 GHz)	0 TO 60 dB ± (0.002 TO 0.1) dB	NONE	MILSTAR
C	WR-15 (50 TO 75 GHz)	0 TO 60 dB ± (0.004 TO 0.1) dB	NONE	SPECIAL PROGRAMS
C	WR-10 (75 TO 110 GHz)	0 TO 50 dB ± (0.01 TO 0.2) dB	LIMITED TO 94 TO 96 GHz AT 0.06 dB/ 10 dB	SPECIAL PROGRAMS, STARTLE, SHORT RANGE RADAR, GUIDANCE AND PASSIVE PROGRAMS

MEASUREMENT SERVICE DEFICIENCIES HIGH POWER

PRIORITY	COAX/W.G. BAND	RANGE/ACCURACY	NBS SERVICE	PROGRAMS
C	TYPE N/TNC (0.001 TO 6 GHz)	0.1 TO 200W ± (1 TO 5)%	NONE	TACAMO, GPS, COMMUNICATION SYSTEMS, TRIDENT, NAVY CALIBRATION PROGRAM NAVIGATION AND SURVEILLANCE SYSTEMS

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MEASUREMENT SERVICE DEFICIENCIES
FIELDS AND ANTENNAS (GAIN-HORNS)

PRIORITY	COAX/W.G. BAND	RANGE/ACCURACY	NBS SERVICE	PROGRAMS
C	WR-22 (33 TO 50 GHz)	GAIN: 24 dB ± 0.10 dB POLARIZATION AND PATTERN	NONE	MILSTAR

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MEASUREMENT SERVICE DEFICIENCIES
POWER DENSITY

PRIORITY	COAX/W.G. BAND	RANGE/ACCURACY	NBS SERVICE	PROGRAMS
D	(0.1 TO 26.5 GHz)	0.1 TO 100 mW/cm² (±0.5 dB)	LIMITED CAP. TO 1 GHz AT 10 mW/cm²	OSHA REGULATION, RADAR SYSTEMS RADIATION HAZARDS, EMI REGULATION ON SHIPS, AND TRI-SERVICE AND INDUSTRY REQUIREMENTS

PNMS

MEASUREMENT SERVICE DEFICIENCIES
PHASE

PRIORITY	COAX/W.G. BAND	RANGE/ACCURACY	NBS SERVICE	PROGRAMS
D	7 mm (GPC-7, N) (0.01 TO 18 GHz)	± 0.05° TO 0.2°	±0.5°	INDUSTRY AND TRI-SERVICE STANDARDS
G	3.5 mm (GPC-3.5) (0.01 TO 26.5 GHz)	± 0.1 TO 0.5°	NONE	GPS, SPACE SHUTTLE, TRIDENT, COMMUNICATION SYSTEMS

PNMS

MILSTAR PHASE NOISE REQUIREMENTS

FREQ. OFFSET FROM CARRIER	CARRIER FREQUENCY, dBC				
	PAYLOAD/TERMINAL	TERMINAL			
	5 MHz	60-80 MHz	1.3-1.4 GHz	6.4-7.5 GHz	43.5-44.5 GHz
1 Hz	-112/-95	—	—	—	—
10 Hz	-125/-125	—	—	—	—
100 Hz	-145/-145	-95	-88	-70	-60
1 KHz	-155/-155	-105	-100	-80	-71
10 KHz	-165/NO SPEC	-115	-110	-93	-81
100 KHz	—	-130	-115	-113	-86
1 MHz	—	-130	-135	-120	-106
10 MHz	—	-130	-135	-120	-106
100 MHz	—	—	-135	-120	-106
1 GHz	—	—		-120	-160

PNMS

MILSTAR

FREQUENCY SWITCHING SPEED (FREQ. HOPPING), ON/OFF TIME

FREQUENCIES:	1.3-7.5 GHz AND 43.5-44.5 GHz
SWITCHING SPEED:	0.9 μs
PHASE SLOPE:	< 5 DEGREE/62 μs
SETTLING TIME:	WITHIN 5 DEGREE OF FINAL PHASE IN MAXIMUM INTERVAL OF 62.9 μs FROM START OF A FREQ. TRANSITION.
ON/OFF TIME: TRANSITION	OFF STATE <60 dB BELOW NORMAL ON STATE
ON/OFF STATES: SWITCHING TIME	< 0.5 μs RELATIVE TO THE START OF OUTPUT FREQUENCY HOP.

SUMMARY

- RECOMMENDED 75 GROUPED PRIORITIES
- IMPROVED UNCERTAINTY/RANGE AND BROADEN PROGRAMS FOR COAXIAL CONNECTOR TYPES AND WAVEGUIDE BAND STANDARDS
- MILSTAR AND WEAPON GUIDANCE SYSTEMS ARE CRITICAL DoD PROGRAMS REQUIRING NEW AND IMPROVED MICROWAVE STANDARDS

PNMS

SECTION 7

JUNE 1986

NATIONAL CALIBRATION PROGRAM PROPOSAL

BY:

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PNMS

There is currently an inadequate "National Calibration Program" to support U. S. Industry, the Department of Defense (DOD) and other government agencies. This lack of national capability includes several technical disciplines. The RF/microwave/millimeter-wave disciplines probably have the most glaring deficiencies and are among the most critical. Over the past decade, the National Bureau of Standards has steadily fallen behind in calibration/measurement capability needed to support industry, DOD, and other government agencies - especially in the RF/microwave/millimeter-wave disciplines. In addition to not keeping up with the support requirements in new technologies and frequency bands, several established services at NBS have been allowed to deteriorate during this era.

OBJECTIVE

The objective of the PNMS is to influence industry, the necessary DOD and other government agencies to provide NBS the necessary support that enables them to develop the calibration and measurement services desperately needed.

A long term national calibration service that includes:

- National standards (all) reside at NBS
- NBS develop, maintain and provide standards, artifacts and measurement services to industry and other government agencies
- NBS develop accepted methods for stating and demonstrating:
  1) Service Capabilities
  2) Traceability
- Calibration methods and processes including consensus standards/processes, documentation, and uncertainty analysis
- System and program for accepted tiered dissemination
- System which allows the achievement of conformance within each tier of the calibration structure - along with flexibility for any user to bypass any echelon of the "tiered" system if necessary to achieve accuracy at a particular level
- Standard Reference Materials (SRM's) - developed, characterized, and sold by NBS - supplied with certificate of calibration/measurement - Examples:
  - SRM's for surface roughness measurement processes
  - SRM's for plating thickness measurement processes
- Measurement Assurance Programs (MAPS) - controlled by NBS - provides certification of laboratory's complete process, not just a

"standard" as is normally supplied with conventional traceability methods - Examples:

- Gage block
- Resistance
- DC Voltage (Standard Cell)
- Mass (weight)
- Laser Power

- o Program that enables industry and other government agencies to identify early measurement/calibration requirements - in the R & D stage of technology development

- o Program that assists the defense industry and other general industry in establishing realistic measurements specifications for programs such as:

    - oo MILSTAR EHF Measurements/Compliance
    - oo EMI Standards

- o RF/Microwave/Millimeter wave standards and measurement support that are adequate to support industry and other government agencies - especially the Department of Defense (DOD), in a timely manner.

- o PNMS recommends that NBS increase emphasis on automation - the objective being improvement of productivity and quality. Some of the benefits to be gained are:

    - Improved and more consistent processes

    - Minimized intensive labor requirements of highly skilled scientists and engineers

    - Reduction of calibration/standards echelons through improved accuracy and efficiency-enabling higher echelon service to be available to more users

- o PNMS does not recommend the increased automation for the sake of automation - it must be cost effective within reasonable resources - and quality must not be sacrificed.

CURRENT STATUS

The current capability, especially the calibration services at the National Bureau of Standards (NBS) is inadequate to support the requirements of industry and various government agencies. The critical need for this national program is exemplified by:

- o NBS capability is inadequate to support current industry and government agency measurement/calibration requirements

- o NBS funding and manpower limitations preventing development of standards/artificats and measurement techniques to support new and rapidly changing technologies

- o Deterioration of existing inadequate capability - due to funding and manpower limitations

INTERIM - WHAT TO DO UNTIL NBS GETS HERE

The PNMS recognizes that in addition to the current lack of critical measurement/calibration services - there will be a minimum of two to three years development time for NBS to provide new services after funding approval is provided. It is recommending a number of options for industry, NBS and other government agencies to use as "interim" measures. These include:

- o Enable faster technology transfer to industry

- o Assist NBS in becoming "future oriented" during the development of new measurement technology. This should include:

  - Increased industry and DOD involvement, training seminars, documentation, technical publications, establish accepted standards/artifacts/measurement techniques, and methods for technology transfer.

  - Institute a legal forum for discussions, evaluations and recommendations planning objectives to meet established needs.

  - Use of other national laboratories by NBS and industry where there is a recognized capability not available in this country.

  - Increased NBS/industry cooperative efforts including participation with NBS during development of capabilities.

  - Purchase of standards - when developed and recognized as adequate - from other National laboratories or industry instead of reinventing and developing at NBS. This can save both development time and money.

- o Use of designated "consensus" laboratories for interim service - NBS should be the facilitator in such a program. The MILSTAR EHF Interim Standards Program is an example of "consensus standards being developed to satisfy a critical DOD project measurement/compliance requirement.

- o Facilitate industry (Buyer/Seller)/DOD intercomparison. Although these may be a good "interim" solution to a lack of a national standard, they must be viewed as a "band-aid" or "stop-gap" measure that often results in definition limitation, limited life cycle, crisis oriented management, and difficult conditions for technology transfer. They are not cost effective alternatives to an adequate National Standards Program - the MILSTAR EHF Interim Standards Program being a prime example:

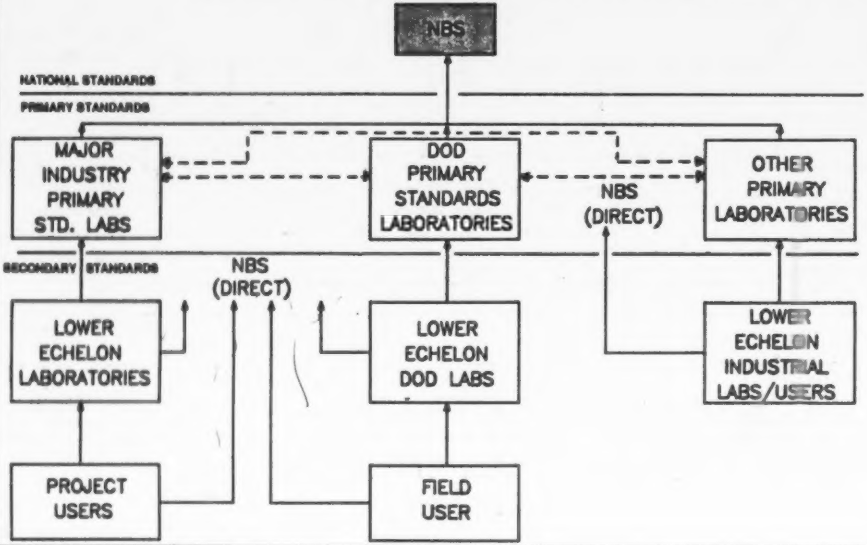
- Estimated annual cost to each of the four current participating laboratories is approximately $250,000. Much of this expenditure would not be necessary if national standards and measurement services were available (preferably at NBS).
- The combined cost will far exceed the cost necessary for NBS to develop the capability.
- Industry costs are eventually reflected in higher costs to DOD and other government agencies.

CONCLUSION

It is the unanimous consensus of the PNMS that there is an urgent requirement for an adequate "National Calibration Program." Sufficient support needs to be provided to enable NBS to become the world-wide recognized National Measurement resource and center of excellence.

The PNMS Program illustrates the current deficiencies, identifies national requirements and priorities, and a recommended calibration plan to correct the current conditions and improve overall NBS support to industry and DOD on future developed services.

PRESENT
NATIONAL CALIBRATION SYSTEM



NBS

NATIONAL STANDARDS

PRIMARY STANDARDS

MAJOR INDUSTRY PRIMARY STD. LABS

DOD PRIMARY STANDARDS LABORATORIES

OTHER PRIMARY LABORATORIES

NBS (DIRECT)

SECONDARY STANDARDS

NBS (DIRECT)

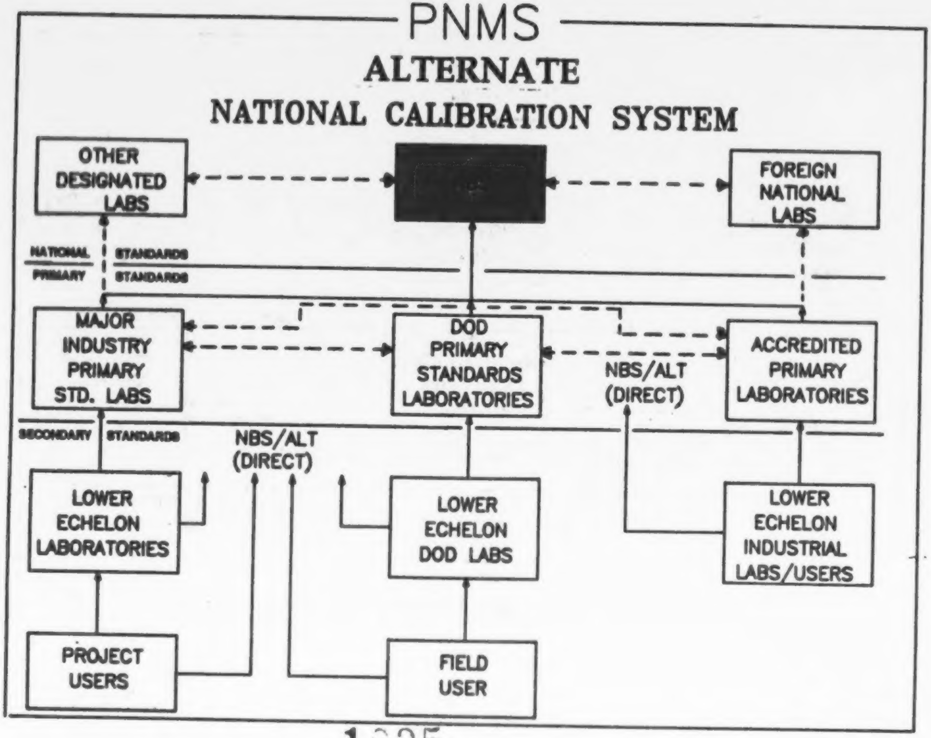
LOWER ECHELON LABORATORIES

LOWER ECHELON DOD LABS

LOWER ECHELON INDUSTRIAL LABS/USERS

PROJECT USERS

FIELD USER



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ALTERNATE NATIONAL CALIBRATION SYSTEM

OTHER DESIGNATED LABS
[redacted]
FOREIGN NATIONAL LABS
NATIONAL
STANDARDS
PRIMARY
STANDARDS
MAJOR INDUSTRY PRIMARY STD. LABS
DOD PRIMARY STANDARDS LABORATORIES
NBS/ALT (DIRECT)
ACCREDITED PRIMARY LABORATORIES
SECONDARY
STANDARDS
NBS/ALT (DIRECT)
LOWER ECHELON LABORATORIES
LOWER ECHELON DOD LABS
LOWER ECHELON INDUSTRIAL LABS/USERS
PROJECT USERS
FIELD USER

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SECTION 8

A - 20 MARCH 1987

RECOMMENDED ACTION PLAN

BY:

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PNMS

The IEEE Microwave Theory and Techniques Society
Committee for the Promotion
of
National Microwave Standards

ACTION PLAN

EXECUTIVE SUMMARY

This plan presents methods and actions to take to complete several key projects that have been defined by the Committee. These projects are required to fill serious gaps in microwave measurement technology support at the National Bureau of Standards.

The Action Plan is presented in sections which provide background and define the problem, then present discussion and required actions. Key action areas include:

a. Finances and Financing: $38 million of additional funds are needed over the next six years and $4 million per year thereafter to attack the 75 projects and maintain their calibration services. Ideas for acquiring private and government funds are presented.

b. Personnel: The NBS microwave staff needs doubling. Interim action teams of government-industry experts are proposed to expedite solutions for extremely serious deficiencies.

c. Equipment/Facilities: 5 to 10,000 sq ft of space are needed for new systems; $1.5 M per year for 5 years and $0.7 M per year thereafter are needed for capital equipment

d. Management Resources and Direction: Higher priorities for measurement standards technology are prescribed. A series of interim and long term goals for NBS are presented to strengthen rresources.

e. Project Objectives and Plans: The continuing role of the Committee is described. The elements of interim and final projects are described. The sequence of project execution is proposed. Relationships of NBS and industry/academia team members are suggested.

Finally, a summary of PNMS and NBS actions are presented. Immediate action calls for the establishment of a financing task force, development of project plans, and, with funds at hand at NBS, execution of the highest priority projects.

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The IEEE MTTS Committee
for the
Promotion of National Microwave Standards

ACTION PLAN

BACKGROUND:

The IEEE MTTS Committee for the Promotion of National Microwave Standards has been formed by a group of concerned individuals who find it in the best interests of their companies and organizations to restore the prowess of NBS to furnish essential national standards and calibration support for the microwave industry.

There has been a serious and growing atrophy of the resources available to the National Bureau of Standards (NBS) to meet the needs of the Nation in the technology areas of millimeter and microwave test, measurement, calibration and standards. Immediate and energetic efforts must be made to solve severe problems in the near term and to develop adequate size and strength of the NBS microwave resources in the long term.

Neglect of NBS as a vital national resource has left the microwave industry of the U.S., and the defense and communication projects it principally supports, without sufficient national measurement references to assure and maintain quality and reliability of outgoing products and deployed systems. Technology development is falling behind and its transfer is being delayed. Also, the microwave industry is further hampered in competing favorably in foreign markets where other governments assure strong national measurement reference competence to support national industries.

THE PROBLEM:

A series of budget trimming actions over a long period of time have seriously reduced NBS microwave resources and capabilities. These reductions have taken place within NBS, within the Department of Commerce (DOC), within the Office of Management and Budget (OMB) and within the committees of Congress. They began in the late 1960's and early 1970's on the erroneous perception that the measurement technology of that time had been advanced adequately to satisfy microwave requirements for many years to come. This was an outgrowth of extensive development efforts for the Department of Defense during the late 1950's and early 1960's. However, the cuts were short sighted. They hurt a major segment of the microwave industry in both cost and delivery time by leaving them without needed calibration services and measurement standards developments to keep pace with emerging technology. They also dismantled a vital resource now needed to support the implementations of a new surge of technology breakthroughs in the mid-1980's. These technology support needs demand national measurement references and capabilities that are the responsibility of NBS to furnish and which do not exist. Members of industry as a whole have been slow to recognize the loss of NBS capability and to respond to the threat created by this loss. They simply assumed that the services would be there when needed as they had been throughout the history of NBS. They also assumed that the pendulum of government economics would swing to restore the more damaging of the reductions. This has not occurred. In fact, it has only grown worse.

The studies of the PNMS have revealed very serious and immediate needs for NBS services and support. These are reflected in the documents of the Committee as derived from a broad base of industry and from the findings of other groups who depend on NBS support, such as the National Conference of Standards Laboratories (NCSL). They reflect a universal requirement that immediate and positive action be taken by NBS and Government to furnish needed resources.

It is the intent of this Action Plan to address these requirements and to establish a direction for corrective action to restore the NBS as a strong central national resource which meets the basic and essential needs of defense, government and industry in the field of millimeter and microwave measurement technology and measurement standards.
The plan covers the following areas: a. Finances and Financing, b. Personnel, c. Equipment/Facilities, d. Management Resources and Direction, e. Project Objectives and Plans

FINANCES and FINANCING:

NBS is woefully short of funds to attack the microwave standards problems now existing. Through an evaluation of essential requirements versus the services that must

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be established and subsequent analysis of the effort to achieve them, the Committee estimates that $ 38 million over the next six years and $4 million per year beyond that date are needed in addition to the FY 1986 baseline amount of $6 million presently funded for the NBS microwave resource. This means a total funding level requirement of $13 million per year through FY 1991 and a $10 million level of effort thereafter.

This continued long term base level funding of $10 million per year for millimeter and microwave support is essential to ensure retention and protection of the competence of the microwave and millimeter wave resource of NBS and to avoid a recurrence of the problem.

NBS and its management must obtain necessary funding to meet these financial needs. The Department of Commerce and the Office of Management and Budget bear the responsibility to acquire the support needed, either directly from Congress, from other agencies of the government, from industry, or, more likely, a combination of all of these.
In addition, several administrative restraints must be relaxed or removed which impede project progress such as severe travel restrictions, technical grade level ceilings. etc.. As a result of prior budget cutting actions and higher level restraints, there appears to have developed in NBS a sense of futility and excessive caution about requesting adequate funds, no matter how essential. Responses by budget reviewers at all levels typically demand extraction of funds from other NBS programs rather than the addition of adequate amounts of new funds. This places NBS in the position of cutting its own throat and makes the insertion of new levels of funding very difficult if not impossible. (The Committee is very aware of serious financial deficiencies at NBS for measurement technology areas other than microwave that also demand support and which should not be a victim of the Committee's efforts to improve the microwave segment of NBS).

The Committee deplores this negative approach to problem solving and believes it must be replaced with one that achieves more success. Management and budgetary actions which cause internal NBS competition can be viewed as healthy when the competitors are of near equal strength and overall finances are adequate. Such is not the case here.

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The microwave faction of NBS is very weak, overloaded and debilitated. They will need strong internal and external support to overcome the significant obstacles they now face. While some redirection of funding within NBS may be tempting and appropriate, in the practical case it is known that the needs for funding far exceed the small amounts that might be shaken free by the trauma of redirection. What is needed is positive actions with clear priorities, goals and expectations and the necessary strategy to acquire needed financial support.

On the premise that the NBS FY 1987 budget request to Congress from the OMB does not address the need for the additional $7 million, it is probably necessary to request special directed action by Congress to assure that the necessary infusion of funding takes place during the authorization and appropriation process. It is essential that the staffs of NBS, DOC, OMB and appropriate committees of the House and Senate work out means to infuse these new funds immediately for FY 1987 and onward.

For the immediate and emergency case we now face, Congress could hold a special appropriations hearing for measurement technology research and development at NBS. In conjunction with, or preparatory to such hearings, the Defense Science Board, Congress's Office of Technology Assessment, and the Congressional Research Service could conduct appropriate studies and assessments of the measurement technology crisis

In the longer term, basic legislation relating to NBS needs to be reviewed and clarifying legislation needs introduction to apply to U.S. Code Title 15 of PL 88-165 of 4 November 1963. This should be done to ensure that the Department of Commerce and NBS are clearly mandated to provide standards of power from "DC to Light", which includes millimeter wave and microwave spectrums, rather than the narrow and erroneous interpretation sometimes utilized. This interpretation presumes that the aforementioned legislation applies only to DC (units of power) and Light (units of flux intensity). By clarifying this area of legislation, the Administration and Congress would be mandated to assure that all required standards support across the entire spectrum of electronic measurement technology be adequately funded at NBS.

PNMS

Other alternative means of funding support for the Nation's measurement technology requirements and those of NBS may need separate study. However, while the Committee's experience in government operations is somewhat limited, some possible options are presented as follows:

a. Determine the prime benefactors, especially end users and suppliers of such services as telephone, satellite, computer communications, etc..Then, undertake actions to obtain funding from the appropriate source. NBS's use of other agency funds, especially those of DOD elements partially does this now. However, there may be private sector elements that may see compelling needs for one or more of the specific requirements that have been identified. If so, then a consortium or individual company could fund and pursue the project/s under contract with NBS, or an NBS-consortium team. Along these same lines, the NBS Automated Manufacturing Research Facility has been cited as a model for loaned/donated equipment and personnel teamwork activities.

b. Congress and the Administration reach agreement that where other government agencies (OA) are the prime benefactors, such as FAA, FCC, NRC, DOE, NASA, DOD,etc., that the budget process will establish or effect transfers of funds from OA program elements directly into NBS with appropriate OA monitoring or through OA control offices to NBS.

c. Congress authorize NBS to sell bonds or shares to the private sector for the accomplishment of specific projects and the funds are paid back from proceeds netted through calibration service charges.

d. Congress mandates the creation of and authorizes funds for a quasi-governmental nonprofit corporation to undertake the projects outlined in this report and, upon completion, transfer them into the NBS for maintenance and operation to be sustained by calibration service charges.

e. Similar to d. above, establish a fiduciary entity comprised of a combination of the major disciplinary engineering societies such as IEEE, ASME, AICHE, ASCE, etc.. This entity could then serve as a collector of private funds for specific projects and contract with NBS or other suitable resources for execution of the projects.

f. Congress authorize the establishment of a financial corpus (loan) from the Treasury for the initiation costs of the projects. NBS would pay back the loan through calibration service charges over a given period of time.

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In addition to the above funding innovations, the Committee for PNMS recognizes that it must be prepared to present the needs for funds in specific terms, to advise on its impact on national defense and industry, and to propose and participate in a plan for both general and specific actions to correct the current deficiencies with whatever means are at our disposal.

Further, the Committee must take as an action item the establishment of a special task force of all interested parties to continuously pursue a multitude of funding paths and support systems to assure execution of the key projects identified by the Committee.

PERSONNEL:

The loss of key NBS scientists and engineers in the microwave fields over recent years demands an immediate restoration plan. A strong recruiting program for new engineers and scientists and lesser quantities of already experienced personnel is essential. The plan must be based on the premise of the receipt of all or segments of the needed funds. To wait until the funds become available to prepare and begin execution of the plan will only delay corrective action projects still further.

The Committee estimates that NBS requires about double their present professional and technical staff assigned to microwave and millimeter wave projects. These personnel need to come from all levels to form up new development teams and include a few program managers, some senior scientists, engineers and technicians and the balance as entry level technical personnel. The emphasis should be placed on engineers and practical scientists to be added to present staff with a focus on accomplishment and implementation of new measurement standards and systems to balance with development activities.

A source of new talent can be found through a recruitment program targeted for fellowship students specifically hired for work on the projects and nurtured to remain as project engineers following graduation. Known in industry as pre-graduate "seed" students, these people are of value directly to the projects and, if properly involved, become committed to stay on the projects following graduation in the face of more lucrative offers elsewhere. Also, principal recruiting attention should be paid to selected colleges and universities which specialize in microwave engineering curricula such as: MIT, Cornell, Illinois, Wisconsin, Georgia Tech, Missouri, etc..

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On the premise that funds do become available, it will take considerable time to acquire new personnel, considerable time to develop their prime abilities to contribute, and extreme difficulty in attracting personnel at salaries that must compete with private industry, whatever the entry level of their experience.

While the need for these personnel is immediate, the acquisition of them and formulation into competent teams will take two to three years at best. Meanwhile, the microwave support problem grows rapidly worse. What is needed are government/industry support groups who can form interim teams of seasoned experts to attack the more immediate of problems and accelerate development and installation of standards and calibration systems at NBS for use by all of U.S. industry. These teams would be responsible for the development, prototyping, documentation, and initial production of prototype hardware, software, methods and training for the implementation and duplication of the finished products and systems. These would then be used at not only NBS, but at those industry sites where similar systems are essential for transmittal of the chain of measurement quality and competence.

In addition, the teams would be the training ground and tutorial sites for the newly acquired NBS employees who would sustain and carry on the development of the additional systems.

In the early stages of the projects, project operations could be a shared responsibilty of both industry and NBS members. From this, further NBS personnel development would emerge through project management experience.

All of these teams need not be sited at NBS. Some of the projects could commence at qualified academic and industrial facilities under the auspices of the committee or a consortium. As the NBS teams become sufficiently staffed and funded, the work could be transferred to NBS, if this is efficient. Indeed, some of the facilities of industry and of universities are already advanced beyond those of NBS in certain areas and should be the focal point for the interim project teams. Further discussion of these teams can be found later in this report as an element under Project Objectives and Plans.

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EQUIPMENT/FACILITES:

There appears to be insufficient space in the microwave elements at NBS for conduct of the new work.
Laboratory rearrangement and certain refurbishment should parallel the initiation of the projects and installation of the calibration systems. The Committee has not yet studied the extent to which additional space is needed, but it is clear that more (5,000 to 10,000 sq ft) will be required.
Also, there is a significant need for additional equipment for the conduct of both development work and the establishment of calibration services. Millimeter wave and microwave capital equipment is especially expensive and creates the need for higher than normal per person investments for supporting development work and high costs for calibration systems that evolve therefrom.
The Committee estimates that of the $ 7 million per year for the added program, about $1.5M per year represents the equipment requirements segment. Immediate needs are for sources, detectors, and comparators in the frequency spectrums of interest. After the initial five years, the follow on funding for equipment should be sustained at about a $ 0.7 million level per year.
During the time that equipment is being obtained and transformed into operating systems with skilled staff, the equipment and facilities of the industrial members of the interim project teams could be used to conduct the most immediate of efforts.

MANAGEMENT RESOURCES AND DIRECTION

The presence of additional funding, added personnel and new equipment will not correct the current deficiencies. At NBS, renewed priorities, spirit, dedication, committment, leadership and direction must combine to use these basic resources for success.
The Committee sees several areas where sound and proven methods from business and industry can be applied to achieve near and longer term success. The Committee, or a newly formed working group from a cadre of PNMS, proposes to participate with NBS in the planning and overview of the key projects. More specifically, there are some observations of the committee that should form part of the process and be useful to NBS management in ensuring near and long term success in making microwave standards, systems and services available to the Nation's government and industry users in a timely and

competent manner:

a. Priorities: First and foremost, the highest priority and subsequent committment must be given by the highest levels of NBS and DOC management to the pursuit of projects that will fulfill the requirements defined and prioritized by the Committee. The priorities of all measurement standards projects at NBS must take precedence over all non-measurement standards activities, including administrative activities of technical personnel. Measurement standards projects can no longer be subordinate to other priorities and goals at NBS. Too much damage has resulted from present priority relationships.
The Committee has defined precise priorities for a multitude of measurement standards requirements elsewhere in the Committee report. These requirements and their respective priorities form the basis for the planning and order of execution of the needed projects. They represent the combined inputs of needs derived from the National Conference of Standards Laboratories, the Department of Defense Calibration Coordination Group, and leading telecommunication and information processing industries.

b. Goals: Project goals must be clearly and crisply defined for the next five years with immediate attention paid to the first three years. These goals must focus on at least the following for each of the requirements defined in this report as reflected by the work of the National Calibration System Sub-committee:

(1) Long Term Goals (for each PNMS requirement):

(a) All national standards will ultimately reside at NBS.

(b) NBS will regain capability to develop, maintain and provide standards, travelling reference artifacts, calibration and special measurement services and will publish preferred measurement and calibration methods to industry and other government agencies.

(c) NBS develops accepted methods for stating and demonstrating both normal and optimum calibration and measurement services capabilities, measurement uncertainties, and traceability.

(d) NBS provides and uses consensus and documented calibration methods and processes.

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(e) NBS defines and participates in operating a tiered dissemination system and program with a minimum number of tiers consistent with logistics to minimize NBS accuracy requirements.

(f) NBS devises a system to achieve conformance within each tier of the calibration structure and the means to confirm such conformance.

(g) NBS disseminates the newly acquired knowledge through user involvement, training seminars, technical publications and documentation of accepted standard procedures, techniques, artifacts and other methods of technology transfer.

(h) NBS conducts effective and routine open forums with all users to establish new or changing requirements and the planning of objectives and projects to meet those requirements.

(i) NBS continuously compares artifact reference standards with those of other nations to assure factual measurement compatability among world economic and trading systems at the highest accuracy levels.

(2) Interim Goals (for expedient satisfaction of PNMS requirements until final goals can be reached):

(a) Use qualified foreign national standards laboratories such as NPL in Britain. NRC in Canada, NML of CSIRO in Australia, and PTB in Germany where there is a recognized capability not available in the U.S.

(b) Purchase, rather than develop and build internally at NBS, standard artifacts from other countries or industry when recognized as the best choice of hardware immediately available.

(c) Use cooperative efforts with joint government industry teams to establish a consensus calibration service in minimum time at the most easily activated and competent site.

(d) Establish Buyer/Seller measurement agreement programs as stop-gap measures using stable relative reference artifacts and round robin methods until an adequate absolute standard artifact and tiered calibration service can be established.

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PROJECT OBJECTIVES AND PLANS:

Before embarking on specifics of project plans, it may be well to express the Committee's views as to the future role of the Committee vis a vis that of NBS in planning and executing the projects discussed in this report.

As presently envisioned, the Committee for PNMS sees its current role as being completed by the publication of this report and its future role as being one of maintaining and updating this report periodically, providing information to support the acquisition of project resources, and providing general guidance, support and direction to a Microwave Standards Working Group, or a similar body, charged with the planning and execution of the projects. PNMS sees NBS's future role as planning and executing each project as prioritized and defined in the report, installing capability for interim services, if required, and installing the final services at NBS and operating the service using controlled and documented procedures and systems. It is proposed that NBS establish the Microwave Standards Working Group and that it be structured with leadership by a senior management official of the Center for Electronics and Electrical Engineering, and comprised of MSWG teams led and staffed by key NBS microwave and millimeter wave experts of the Boulder and Gaithersburg facilities, as appropriate. The ongoing Committee for PNMS and the MSWG would maintain a continuous liaison relationship. It is envisioned that present and new members of the Committee would work with counterpart NBS/MSWG project leaders for direct project support or liaison purposes. The Head of the MSWG and senior NBS management would then interact with the Chairman of the Committee on overall MSWG direction and objectives with Committee members serving to provide technical support, feed-back on progress status and input of new requirements information for report up-date purposes.

The Committee has already layed out general elements of interim and final Corrective Action Project Plans (CAPP) they feel express needed schedule and deliverable definitions. Using these or very similar equivalents, the MSWG could then provide leadership, participation, and monitoring of appropriate groupings of projects into some logical relationship (parameter and/or frequency). The MSWG could then establish Corrective Action Project Teams (CAPT) to develop interim and final CAPPs for each identified PNMS

PNMS

requirement. The CAPTs would then coordinate review of each CAPP with the MSWG with PNMS serving in an advisory capacity to confirm that planned project priorities, actions and milestones are mutually acceptable. To assure PNMS and public/user awareness of progress, the MSWG could then maintain an overall CAPP summary to provide review status and visibility of all CAPPs.

The general project elements that PNMS has established for each Interim and Final CAPP are as follows:

a. Requirement:...as defined in PNMS priority matrix including the motivation and justification for the project in terms of benefit and impacts. Wherever possible, identify the principal industrial or government agencies that stand to benefit from provision of the service.

b. Priority:...as defined by the PNMS project priority matrix.

c. Current Status:...at NBS, national (government and non-government), and foreign government laboratories as it relates to the requirement.

d. Corrective Action Project Team (CAPT) Configuration:...the leader and members of each individual project team.

e. Approach and Deliverables:

(1) Artifact standards and systems (describes travelling reference standards, absolute reference standards and calibration systems that the project is intended to produce in as much detail as present knowledge allows)

(2) Documentation planned (error analysis, calibration processes, software/error correction processes, automation scenarios, calibration system evaluation reports.)

(3) Operational service (describes the standards that the service is intended to calibrate and the general scheme of operation).

f. Resources Required:....finances, people, space, equipment, travel, etc. and possible sources of each resource for the interim or final plans being discussed.

g. Execution Schedules:....milestones, dates, critical path items, etc.

h. Project Title and Designator:....an appropriate title and an alpha-numeric code to distinguish between projects. (The designator serves as a locator for the PNMS project vs priority matrix which contains a priority designator.)

It is intended that the composite of the CAPPs will establish the basis for ongoing PNMS-MSWG/NBS interface and project execution/review and justification. It will also provide PNMS and others with a specific basis for support of project budget requirements, possible sources of industrial and other agency funding, personnel assistance, equipment loans/donations and the ability to more effectively assist and support the NBS budget process.

SUMMARY AND FUTURE DIRECTIONS:

The IEEE Microwave Theory and Techniques Society Committee for the Promotion of National Microwave Standards is committed to define and prioritize requirements and participate the provision of adequate national microwave and millimeter wave calibration and standardization services for the defense, government and industrial segments of the United States. The Committee considers the National Bureau of Standards as the legal and logical focus for the availability of the Nation's highest accuracy calibration services consistent with national requirements.
The Committee is strongly supportive of any activities, especially those of the NBS, directed to that measurement science and technology which fulfills needs in the near term and which advances the technology for longer term projected needs. Had adequate funds been available to NBS in the past, the Committee involvement could be confined to requirement and priority identification. However, in the absence of adequate levels of financial support to NBS, the Committee sees itself in a continuous effort of vigilance and activity to educate, inform and support acquisition of resources to fulfill identified requirements. Further, the Committee intends to serve on behalf of IEEE as one of the principal national agents in monitoring and evaluating the continued viability of the NBS to provide timely and adequate millimeter and microwave measurement technology support to the Nation in the

form of calibration systems and services.

To assure the execution of the projects defined by this report and future reports, the Committee proposes the establishment of a Microwave Standards Working Group at NBS to accomplish the following:

a. Identify and prioritize national requirements for millimeter wave and microwave calibration standards, systems, and services. Do this on a continuous basis in coordination with the Committee.

b. Review current calibration support status for each PNMS requirement; analyze and evaluate alternative calibration and measurement support systems; and identify unmet requirements.

c. Define appropriate actions and resources necessary to fulfill the identified requirements through interim and final action projects.

d. Form Corrective Action Project Teams (CAPT) to attack the unmet requirements. Establish necessary funding sources to provide funding and technical support schemes for each project and subsequent calibration services.

e. Designate CAPT members to be responsible for specific projects or groups of projects. Develop Corrective Action Project Plans (CAPP) for each of the identified requirements through interaction with PNMS.

Further, the Committee sees the following as being among the continuing and essential responsibilities of NBS:

a. Assure that the primary activity at NBS is directed to the pursuit of the projects and programs associated with measurement technology leading to calibration systems and services for the Nation.

b. Determine requirements and priorities for NBS calibration services for the near and far term through interaction with PNMS, NCSL, DOD/CCB, and other NBS users from inputs derived from periodically held open forums.

c. Provide strong and sustained support to the Microwave Standards Working Group and assure its open and effective relationship with PNMS.

d. Acquire identified financial resources from appropriate users such as the private sector, Congress, or other government agencies through aggressive presentation of the requirements and their impact on productivity, quality, technological progress international competitiveness and economic interests of the U.S.. Acquire needed personnel resources from qualified academic, industrial, and foreign and domestic sources, either through paid or voluntary means. Take immediate action to obtain funding resources from a variety of sources pursuing the options outlined in this report and others that may prove fruitful.

e. Diligently execute the funded projects in the order of priority established, using both internal and external resources as needed to assure prompt and effective project execution.

f. Assure that each completed project, in both its interim and final stages, meets the precepts outlined for NBS in the Management Resources and Direction section of this Action Plan and that existing NBS calibration systems and services are operated under the same precepts.

g. Utilize the Committee for PNMS as the principal agent for monitoring the microwave and millimeter wave measurement standards elements of NBS. Through continued coordination and cooperation between PNMS and the new Microwave Standards Working Group, assure that the microwave measurement technology segment of NBS becomes, then remains, suitably strong and viable to assure continued high quality and timely support to the microwave industry of the United States.

h. Vigorously advertise and promote efficient and effective calibration services that will yield revenues of adequate magnitude to encourage private support of projects in their development stages without unduly burdening calibration service users.

KEY AND IMMEDIATE ACTIONS:

1. FOR NBS: Form a task force with OMB, DOC, NBS, DOD and other affected government agencies to establish the means of developing full funding support for the requirements identified by this report.

2. FOR NBS: Establish the Microwave Standards Working Group and get Corrective Action Project Teams underway to develop CAPPs for each of the identified projects and begin executing the projects with whatever funds are at hand.

3. FOR IEEE: Establish a permanent role role for the Committee for the Promotion of National Microwave Standards to assure ongoing vigilance and support to our national microwave and millimeter wave measurement standards needs.

PNMS

4. FOR THE GOVERNMENT: Finally, to restate the Committee's concern with the future of NBS, it is essential that all responsible authorities of the Administration and Congress take actions to assure that measurement standards development and calibration services are supported and made Priority No.1 at the National Bureau of Standards.

NMRC 86-01

NATIONAL CONFERENCE
OF
STANDARDS LABORATORIES

Report by the

NATIONAL MEASUREMENT
REQUIREMENTS COMMITTEE

September 1986

Rev.1 February 1987

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INTRODUCTION AND SUMMARY

Background

During 1982, over 400 organizations within the United States (346 industry, 61 government, and four universities) responded to a survey conducted by the National Conference of Standards Laboratories' National Measurements Requirements Committee (NMRC). The broad objectives of the survey were to:

- Identify requirements for new or improved calibration services from the National Bureau of Standards (NBS) that are necessary for national interests including commerce, international competitiveness and defense preparedness.
- Identify new measurement requirements to establish or improve technical, quality and productivity aspects of individual organizations.

The report of the survey (ref [1]), published in May 1983, was widely distributed and endorsed by industry and government agencies. NBS addressed many issues indicated in the report and a response (ref [2]) was released in March 1984. Further updates to the response and additional NBS calibration services are shown in references [3] through [8].

Essentially, the 1982 survey identified critical needs for increased NBS support in the form of new or improved NBS calibration services in over 20 measurement areas. The survey report noted that the impact of not having the NBS calibration service at that time or in the near future would significantly affect the following:

- Quality of goods and services
- Readiness of national defense capabilities
- International Commerce and Competitiveness
- Productivity improvement
- Verifiable product performance
- High technology product development

Scope of this Report

To determine the current (1986) status of national measurement requirements, especially for new and improved NBS calibration services the NMRC subcommittees have reassessed the earlier noted deficiencies by comparing them to the NBS responses (references [2] through [8]) and by obtaining additional input from the industrial community. Two open conferences were held to assure broad assessment and discussion of requirements and in all cases, NBS personnel were consulted to assure correctness of the information especially in terms of present and future NBS plans.

Each of the five NMRC subcommittees summarized their results by measurement parameter. These results appear in Sections 2 through 5 of this report. Each measurement parameter summary identifies any measurement requirements uncovered in the 1982 survey which are still not satisfied, current NBS status, what industries and application are affected by the deficiency with related impact, and what new requirements have been determined. It should be noted that parameters within each NMRC subcommittee are presented in alphabetic and not in priority order. NMRC and subcommittee chairmen are identified below. Members of each subcommittee are identified their respective section.

National Measurement Requirements Committee (NMRC)	- K. B. Jaeger, Chairman Lockheed Missiles & Space Co.
NMRC DC - Low Frequency Metrology Subcommittee	- B. Lloyd, Chairman John Fluke Mfg. Co.,Inc.
NMRC RF - Microwave Metrology Subcommittee	- F. K. Koide, Chairman Science Applications International Corp.
NMRC Electro - Optics Metrology Subcommittee	- K. B. Jaeger, Temporary Chairman
NMRC Temperature - Pressure Metrology Subcommittee	- L. H. Baker, Chairman Rockwell International
NMRC Physical - Dimensional Metrology Subcommittee	- R. Tobias, Chairman TRW

Summary of Results

In order to gain an appreciation of the needs for improved standards calibration support, we have summarized the results of each subcommittee into individual tables, listed on the next few pages. These tables show that 87 of the original 97 deficiencies identified in the 1982 report still remain unresolved and although 43 of these are presently in work at NBS, an additional 58 deficiencies have been identified by the NMRC subcommittees since the 1982 report. If this rate of identifying deficiencies and resolving them continues, there would be 305 national measurement requirement deficiencies identified by the year 2000 and only 36 of these would be resolved. Therefore, it is obvious that with the current NBS resources being applied, the rate of accomplishment is not sufficient.

It is true that some unresolved measurement requirements are more important than others in terms of urgency and impact. It is also clear that a few are on the threshold of being resolved through active pursuit by the NBS. However, on balance, it is evident that increased emphasis on the part of the NBS to provide new and improved calibration services is needed. The NMRC/NCSL stands ready to enter into discussion with the NBS to help identify and prioritize the most critical requirements. The NBS, for their part, must make a long term commitment to provide a significant increase in services to satisfy not only the identified requirements but to sustain a high level of support for newly emerging requirements.

A recent statement by Department of Commerce Secretary Malcolm Baldridge spelled out NBS's role as the "only national laboratory with the specific mission of directly serving industry" and that the National Bureau of Standards "has been advancing U. S. industrial competitiveness since it was established at the turn of the century." Secretary Baldridge also characterized NBS' measurement related work in virtually every area of science and technology as helping U.S. firms be successful in the market place (ref [9]). It's clear that NBS' unique role and significant effect on our national interests requires our strong support. This report has identified 145 measurement requirements that are currently deficient and need the NBS support described by Secretary Baldridge.

DC-LOW FREQUENCY

	NUMBER OF ITEMS IDENTIFIED FOR EACH CATEGORY								
Categories	Old Requirements Status				New Requirements Status				Total Requirements
	NC	PS	US	UD	NC	PS	US	UD	OLD + NEW
AC Voltage	1			2					3 + 0 = 3
Capacitance	2	1	1				1		4 + 1 = 5
DC Voltage	1			3					4 + 0 = 4
DC and AC Resistance	2	2					2		4 + 2 = 6
DC/Low Frequency Energy and Power				4					4 + 0 = 4
DC/LF Ratio							1		0 + 1 = 1
Inductance							3		0 + 3 = 3
Low Frequency Phase Angle	3	1							4 + 0 = 4
Magnetic Field Strength	2						1		2 + 1 = 3
TOTAL	11	4	1	9	-	-	8	-	
	25				8				25 + 8 = 33

Key to Abbreviation:

NC => No NBS Capability for Items in this Category
PS => Partial NBS Capability for Items in this Category
US => Unknown NBS Status for Items in this Category
UD => Under NBS Development for Items in this Category

RF - MICROWAVE

	NUMBER OF ITEMS IDENTIFIED FOR EACH CATEGORY								
Categories	Old Requirements Status				New Requirements Status				Total Requirements
	NC	PS	US	UD	NC	PS	US	UD	OLD + NEW
Impedance/ Admittance	4	1							5 + 0 = 5
Q - Factor		1							1 + 0 = 1
Low/High Power	6	1						3	7 + 3 = 10
Noise Temperature	1	1		1					3 + 0 = 3
Attenuation	2	1							3 + 0 = 3
Phase Noise						1			0 + 1 = 1
Antenna Gain	1								1 + 0 = 1
Power Density		1							1 + 0 = 1
TOTAL	14	6	-	1	-	1		3	21 + 4 = 25
	21				4				

Key to Abbreviation:

NC => No NBS Capability for Items in this Category

PS => Partial NBS Capability for Items in this Category

US => Unknown NBS Status for Items in this Category

UD => Under NBS Development for Items in this Category

ELECTRO - OPTICS

Categories	NUMBER OF ITEMS IDENTIFIED FOR EACH CATEGORY								
	Old Requirements Status				New Requirements Status				Total Requirements
	NC	PS	US	UD	NC	PS	US	UD	OLD + NEW
Ambient Temper. Temperature Blackbody		1					1		1 + 1 = 2
Cryogenic Blackbody Calibration	1								1 + 0 = 1
Detector Spectral Response		1					3		1 + 3 = 4
FTRI Spectrophotometer Photometric Scale Calibration Standards				1					1 + 0 = 1
IR Window and Filter Transmission				1					1 + 0 = 1
Reflectance (Diffuse)			1						1 + 0 = 1
Reflectance (Specular)			1						1 + 0 = 1
Laser Beam Profile								1	0 + 1 = 1
Laser Mode Evaluation								1	0 + 1 = 1
Laser Power/Energy		1		1			2		2 + 2 = 4
Laser Attenuation							1		0 + 1 = 1
Laser Pointing and Tracking							1		0 + 1 = 1

ELECTRO - OPTICS (continued)

	NUMBER OF ITEMS IDENTIFIED FOR EACH CATEGORY								
Categories	Old Requirements Status				New Requirements Status				Total Requirements
	NC	PS	US	UD	NC	PS	US	UD	OLD + NEW
Optical Fiber Characteristics							3		0 + 3 = 3
Optical Power Meters		1					1		1 + 1 = 2
OTDR Optical Time Domain Reflectometer Calibration		1							1 + 0 = 1
Detector Spectral Response		2					1		2 + 1 = 3
Fiber Optic Attenuators							2		0 + 2 = 2
Optical Fiber Local Area Network								1	0 + 1 = 1
TOTAL	1	7	2	3	-	-	15	3	13 + 18 = 31
	13				18				

Key to Abbreviation:

NC => No NBS Capability for Items in this Category

PS => Partial NBS Capability for Items in this Category

US => Unknown NBS Status for Items in this Category

UD => Under NBS Development for Items in this Category

TEMPERATURE - PRESSURE

	NUMBER OF ITEMS IDENTIFIED FOR EACH CATEGORY								
Categories	Old Requirements Status				New Requirements Status				Total Requirements
	NC	PS	US	UD	NC	PS	US	UD	OLD + NEW
Electrolytic Conductivity	2						1		2 + 1 = 3
Liquid and Gas Flow	3			2			2		5 + 2 = 7
Pressure	1	2					2		3 + 2 = 5
Temperature	2	1		2			3		5 + 3 = 8
Thermal Conductivity Heat Flux				2					2 + 0 = 2
Vacuum	2			1			1		3 + 1 = 4
Vacuum - Leak Rate				1			3		1 + 3 = 4
TOTAL	10	3	-	8	-	-	12	-	21 + 12 = 33
	21				12				

Key to Abbreviation:

NC => No NBS Capability for Items in this Category
PS => Partial NBS Capability for Items in this Category
US => Unknown NBS Status for Items in this Category
UD => Under NBS Development for Items in this Category

PHYSICAL - DIMENSIONAL

Categories	NUMBER OF ITEMS IDENTIFIED FOR EACH CATEGORY								
	Old Requirements Status				New Requirements Status				Total Requirements
	NC	PS	US	UD	NC	PS	US	UD	OLD + NEW
Dimensional (Coordinate Measuring Machine)	2			1			2		3 + 2 = 5
Flatness	1								1 + 0 = 1
Force						1	2		0 + 3 = 3
Gloss					2				0 + 2 = 2
Hardness Testing	1								1 + 0 = 1
Haze					1				0 + 1 = 1
Hygrometry							1		0 + 1 = 1
Length (Gage Block)							2		0 + 2 = 2
Mass							1	1	0 + 2 = 2
Particle Standards				1					1 + 0 = 1
Surface Roughness Surface Finish						2	1		0 + 3 = 3
TOTAL	4	-	-	2	3	3	9	1	6 + 16 = 22
	6				16				

Key to Abbreviation:

NC => No NBS Capability for Items in this Category

PS => Partial NBS Capability for Items in this Category

US => Unknown NBS Status for Items in this Category

UD => Under NBS Development for Items in this Category

SUMMARY OF ALL SUBCOMMITTEES

Categories	NUMBER OF ITEMS IDENTIFIED FOR EACH CATEGORY								
	Old Requirements Status				New Requirements Status				Total Requirements
	NC	PS	US	UD	NC	PS	US	UD	OLD + NEW
DC - Low Frequency	11	4	1	9	-	-	8	-	25 + 8 = 33
RF - Microwave	14	6	-	1	-	1		3	21 + 4 = 25
Electro - Optics	1	7	2	3	-	-	15	3	13 + 18 = 31
Temperature - Pressure	10	3	-	8	-	-	12	-	21 + 12 = 33
Physical - Dimensional	4	-	-	2	3	3	9	1	6 + 16 = 22
TOTAL	47	20	3	23	3	4	47	4	
	87				58				87 + 58 + 145

Key to Abbreviation:

NC => No NBS Capability for Items in this Category

PS => Partial NBS Capability for Items in this Category

US => Unknown NBS Status for Items in this Category

UD => Under NBS Development for Items in this Category

SUBCOMMITTEE I: DC - LOW FREQUENCY

CATEGORIES

Capacitance
Current (AC)
Current (DC)
Electric Power
Inductance
Magnetics
Phase
Resistance (DC)
Resistance (AC)
Volt (AC)
Volt (DC)

INTRODUCTION

It has not been the intention of this group to describe the capability of the NBS, but to determine new or unproved service requirements in the DC and Low Frequency subcommittee. This report does not include all the comments of our respondees but only those items that have showed up in multiple occasions as immediate or near future requirements. No attempt has been made to forecast any long term increases in requirements.

The two areas in DC and Low Frequency requirements that seem to be furthest from satisfactory services are:

a.) Capacitance

b.) Magnetic Field Strength

However, the relative importance of the sub-categories has not been attempted and is not to be inferred from the alphabetical listing.

COMMITTEE MEMBERS

CHAIRMAN	**PARAMETER**
Barry Lloyd John Fluke Mfg. Co., Inc. P.O. Box C9090 MS 274G Everett, WA 98206 Tel: (206) 356-5030	DC Voltage
MEMBERS	
Chu-Min Fu Lockheed Missiles & Space Co. Bldg. 195A, 0/48-71 P.O. Box 3504 Sunnyvale, CA 94088-3504 Tel: (408) 756-0277	AC Voltage
Les Huntley John Fluke Mfg. Co., Inc. P.O. Box C9090 MS 144F Everett, WA 98206 Tel: (206) 356-5088	A/D-D/A
Brian Moore US Army TMDE Support Group MS: DRXTM-SE Redstone Arsenal, AL 35898 Tel: (205) 876-5364 Autovon 876-5364	Capacitance
Richard Semer AGMC/MLEA Newark AFS, OH 43055 Tel: (614) 522-7793 Autovon 580-77	AC-DC Resistance
Tom Short Bonneville Power Administration P.O. Box 491 Vancouver, WA 98660 Tel: (206) 690-2695	Power & Energy Phase Angle

COMMITTEE MEMBERS (CONTINUED)

MEMBERS	PARAMETER
Ray Wade FATC Ford Road EV26 Newport Beach, CA 92629 Tel: (714) 720-4729	Magnetic Field Strength

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PARAMETER: AC VOLTAGE

UNITS: Volt (V)

REQUIREMENTS

1.) Reduce turnaround time to 4 weeks.
2.) New AC Voltage transfer standard with 2.5 ppm transfer uncertainty.
3.) AC Voltage MAP to 1 MHz with total uncertaintie at ± 10 ppm at midband (40 Hz to 20 kHz).

STATUS at NBS

1.) Automating calibration service. Performing service at higher voltage/frequency points (1000 volts, >1 MHz).
2.) Studying new Multi-Junction Thermocouples (MJTC) and special Single-Junction Thermocouples (JTC) plus solid state converters.
3.) Making preliminary feasibility studies of MAPs.

A.) Unknown

INDUSTRIES AFFECTED

1.) Commercial Industries
2.) Department of Defense
3.) Industrial Manufacturing and Service

APPLICATION and IMPACT

1.) Hindering development and calibration of new products.

NEW REQUIREMENTS

None

SPECIAL COMMENTS

None

PARAMETER: CAPACITANCE

UNITS: Farads (F)

REQUIREMENTS

1.) Capacitance MAP services, 10 pF to 1 mF at frequencies from 1 kHz to 1 MHz.
2.) Measurement of the dissipation factor of standard capacitors.
3.) Calibration of four terminal standard capacitors with values up to 1 F at 100 Hz, 120 Hz, and 1 kHz.
4.) Capacitor for calibrating high frequency capacitance bridges.

STATUS at NBS

1.) MAP services in the capacitance area have been suspended until new transport standards can be obtained. Future work in this area is expected to increase the frequency range.
2.) Dissipation factor measurements are not available at the present time but future work is expected to provide that service with an accuracy better than 1 ppm.
3.) Calibration services limited to 0.1 uF at frequencies up to 10 kHz.
4.) Unknown

A.) Unknown

INDUSTRIES AFFECTED

1.) Electronic (Component and Instrument)
2.) Department of Defense
3.) Aerospace Industry

APPLICATION and IMPACT

1.) Limiting usage of C bridges at frequencies above 1 kHz.

NEW REQUIREMENTS

A.) Extend the frequency range of the calibration of four terminal capacitors to frequencies above 1 MHz with accuracies of +/- 0.01 %.

SPECIAL COMMENTS

None

PARAMETER: DC VOLTAGE

UNITS: Volt (V)

REQUIREMENTS

1.) 10 Volt MAP and calibration service. Uncertainties 0.1 - 0.3 ppm at 10 volts.
2.) 0.01 to 1000. Volt MAP or calibration service. Uncertainties 1 - 10 ppm.
3.) 1. Volt MAP. Uncertainty 0.1 - 0.2 ppm. Reduce turnaround time to 4 weeks.
4.) Coordination of the impending change in the legal volt.

STATUS at NBS .

1.) Preliminary testing has started. Uncertainty of 0.3 ppm is achievable; 0.1 ppm uncertainty remains to be seen.
2.) NBS ratio capability needs improvement. At present staffing level this may take 2-3 years with a start in 1987.
3.) Two MAP's are currently available, however, only at 0.3 to 0.5 ppm. The use of unsaturated cells was attempted for 0.1 to 0.2 ppm uncertainty and failed. Presently working on the approach of Zener diodes and resistive dividers for this better MAP uncertainty request.
4.) Special NBS-Industry-Department of Defense committee has been formed to facilitate the transition to the new voltage value.

A.) NBS provides 10v calibration service for the existing solid state 10v standards.

INDUSTRIES AFFECTED

1.) Department of Defense
2.) Aerospace Industry
3.) Instrument Manufacturer

APPLICATION and IMPACT

1.) Measurements for quality and productivity can be limited by the lack of good MAP programs. As the basis of most other measurements, i.e. AC by transfer, the lack of good DC uncertainties means many other measurements are affected.

NEW REQUIREMENTS

A.) Developing 10v DC transfer standard.

SPECIAL COMMENTS

None

PARAMETER: DC AND AC RESISTANCE

UNITS: Ohm

REQUIREMENTS

1.) Calibration service for AC resistance (0.1 to 10**5 ohms, four terminal, 60 Hz to 10 MHz, better than 0.1 % accuracy.)
2.) Reinstate high value calibration service (10**11 - 10**15 ohms, three terminal, better than 0.2 % accuracy.) Improved standard up to 10**15 ohms.
3.) Calibrate shunts to currents of 3000 amperes with accuracies up to 50 ppm.
4.) Reinstate calibration services for ratio devices.

STATUS at NBS

1.) No plans for above 1 ohm and 10 kHz.
2.) Services available for range 1 ohm to 10 ohms between 1.5 and 500 volts. Automated measurement system is installed.
3.) Presently capable of 1 kamperes at 0.01 %. No plans to improve capability. National Research Council of Canada goes to 4.5 kamps (AC) and meets the low demand.
4.) No plans to reinstate services for ratio devices.

A.) Unknown

INDUSTRIES AFFECTED

1.) Aerospace Industries
2.) Component Manufacturing
3.) Research and Development
4.) Nuclear Weapon Production
5.) Particle Beam Accelerators

APPLICATION and IMPACT

1.) There are "paperwork" difficulties that aerospace companies have dealing with Canada's NRC since they have no agency representation in the U.S..

NEW REQUIREMENTS

A.) Platinum Resistance Thermometer (PRT) need for 100. ohm service.

PARAMETER: DC AND AC RESISTANCE (CONTINUED)

NEW REQUIREMENTS (CONTINUED)

8.) Provide support for HP bridges (4-port, 8-terminals) resistors to 10 MHz.

SPECIAL COMMENTS

1.) Concern was expressed about trend toward NBS reduction in services and increased turnaround time.
2.) A need was also noted for more seminars and technical literature.
3.) NBS states that future seminars on ratio measurements will be considered.

PARAMETER: DC/LOW FREQUENCY ENERGY AND POWER

UNITS: Joules and Watts

REQUIREMENTS

1.) Reduce low frequency energy and power calibration uncertainty to 50 - 100 ppm level.
2.) Provide calibration at any power factor.
3.) Provide VAR/VAR hour calibration at 200 ppm uncertainty level.
4.) Extend the range of inputs for which calibrations are made:

    a.) Potential to 600 V
    b.) Current to 50 A
    c.) Frequency to 5 kHz

STATUS at NBS

1.) Present low frequency energy/power calibration uncertainty 500 ppm; working to goal of 100 - 500 ppm uncertainty on a routine basis.
2.) Present power factor capability is 0.5 and 1.; working to develop facility for any power factor.
3.) No VAR capability now; new facility will have VAR capability.
4.) Present calibrations can be at many fixed potentials from 110 to 480 volts; many currents from 0.5 to 75. amperes, and at power frequencies from 50 Hz to 400 Hz. Facility being developed will have potential from 10 to 240 volts, current from 0.01 to 10. amperes and frequencies from 40 Hz to 10 kHz.

INDUSTRIES AFFECTED

1.) Electric Utilities
2.) Instrument Manufacturers
3.) Aerospace Industry

APPLICATION and IMPACT

1.) Power/energy metering (100 ppm for one nuclear plant output for one year is about 1 million kilowatt hours.)
2.) Operating efficiency determination for AC electrical devices.
3.) Production line instrument test.

PARAMETER: DC/LOW FREQUENCY ENERGY AND POWER (CONTINTUED)

NEW REQUIREMENTS

None

SPECIAL COMMENTS

None

PARAMETER: DC/LF RATIO

UNITS: Ratio

REQUIREMENTS

1.) No old requirements.

STATUS AT NBS

A.) Unknown

INDUSTRIES AFFECTED

1.) Electronic Instrument Manufacturers
2.) Aerospace

APPLICATION and IMPACT

1.) Existing DC Ratio devices, such as the 7-dial Kelvin-Varley divider and the self-calibrating reference dividers, are marginally accptable for the scaling at the accuracies required for consistency with the more accurate standards. Needed are the devices which provide ratios with uncertainties samller than 0.1 ppm of output at ratios of 10:1 and 100:1, and scaling devices, such as Kelvin-Varley dividers, for finely subdividing the basic values, and decade multiples of them, to uncertainties of +/- 0.1 ppm or smaller.

2.) Existing high accuracy ratio devices for AC do not operate above 10 kHz. There is a current need for high accuracy (<= 100 ppm) scaling of AC voltage to frequencies of 1 MHz and lesser accuracy (0.1% uncertainty) to 10 MHz. The major problem is in obtaining a few millivolts from the 0.5 volt standards commonly available.

PARAMETER: DC/LF RATIO (CONTINUED)

NEW REQUIREMENTS

A.) While it is true that ratio is a dimensionless quantity for which no standard is required, it is necessary to provide a means by which one may verify that ratio/scaling apparatus provides the accuracy claimed. This can be accomplished by means of a calibration service which compares a customer's ratio device to a standard device or by means of a Measurement Assurance Program which enables a customer to verify his realization of a particular multiple or submultiple of various quantities.

SPECIAL COMMENTS

None

PARAMETER: INDUCTANCE

UNITS: Henrys (H)

REQUIREMENTS

1.) No old requirements.

STATUS at NBS

A.) Unknown
B.) Unknown
C.) Unknown

INDUSTRIES AFFECTED

1.) Aerospace Industry
2.) Electronic Instrument Manufacturers

APPLICATION and IMPACT

1.) Used in switching power supplies for spaceborn and missile guidance systems.

NEW REQUIREMENTS

A.) Appropriate calibration service up to 10 MHz.
B.) Measurement techniques and procedures.
C.) Artifact design.

SPECIAL COMMENTS

1.) The items identified under "New Requirements" constitute a recent development and demand by industry and hence warrant attention by NBS.

PARAMETER: LOW FREQUENCY PHASE ANGLE

UNITS: Degrees

REQUIREMENTS

1.) Provide low frequency phase angle calibration uncertainty at +/- 0.005 degree level.
2.) Provide calibrations for frequencies from about 20 Hz to 100 kHz.
3.) Most users require potential : potential phase measurement at 20 mV to 300 volts, but some require potential : current and current : current up to 50 amperes.
4.) A workshop/seminar on precision phase measurement procedures.

STATUS at NBS

1.) Phase angle calibration is offered as a special test; NBS is working toward +/- 0.005 degree uncertainty for low frequency balanced signals and up to +/- 0.02 degree at high frequency.
2.) The standard is a two-channel source. The NBS trial program now calibrates for 2 Hz to 5 kHz, extension for 10 Hz to 50 kHz is planned.
3.) The NBS trial program calibrates potential : potential and potential : current at potentials from 0.25 V to 100 V and currents up to 5 amperes. An amplifier to increase output potentials to 500 volts is being planned.
4.) No separate workshop is planned; this subject has been included in Low Frequency Measurement workshops. This will be treated in 1986 as part of a special publications; the next workshop is planned for 1986.

INDUSTRIES AFFECTED

1.) Aerospace
2.) Instrument Manufacturers
3.) Electrical Utilities

APPLICATION and IMPACT

1.) Device phase shift and stability
2.) Power factor accuracy in power calibration
3.) Production line instrument test

PARAMETER: LOW FREQUENCY PHASE ANGLE (CONTINUED)

NEW REQUIREMENTS

None

SPECIAL COMMENTS

None

PARAMETER: MAGNETIC FIELD STRENGTH

UNITS: Gauss

REQUIREMENTS

1.) Restore calibration service for permanent magnets.
2.) Develop capability to calibrate AC magnetic fields.

STATUS at NBS

1.) NBS has access to questionaire results which will determine future direction of magnetic work.
2.) Unknown and unplanned.
3.) NBS sees its role as assisting industry with well documented measurement techniques.

A.) Unknown

INDUSTRIES AFFECTED

1.) Nuclear Medicine
2.) Computer Magnetic Recording Industry
3.) Aerospace Industry

APPLICATION and IMPACT

1.) Improved product reliability
2.) Improved ability to meet specification
3.) Improved product features

NEW REQUIREMENTS

A.) Magnetic measurement areas "such as magnetic recording media." Measurement workshops were requested. These the NBS sees as sources of input for additional needs and desires.

SPECIAL COMMENTS

None

SUBCOMMITTEE II: RF - MICROWAVE

CATEGORIES

- Admittance
- Antenna Gain
- Attenuation
- Dielectric Constants
- Field Strength
- Frequency
- Impedence-Admittance
- Microwave Power Density
- Noise Temperature
- RF - Magnetic Field Strength
- Phase Noise
- Phase Shift VOR
- Power
- Pulse Rise Time
- Voltage/Pulse Time Modulation

INTRODUCTION

The purpose of this report is to update information contained in the Microwave Requirements and Priority Section of the 1983 NCSL Measurement Requirements Survey and to add any new requirements that have been identified since that report was prepared. Eight parameters are covered in detail including comments in regard to the status at NBS and the impact on industry as well as calibration agencies.

1.) Impedance
2.) Q-Factor
3.) Low/High Power
4.) Noise Temperature
5.) Attenuation
6.) Phase Noise
7.) Antenna Gain
8.) Power Density

A list of priorities has also been added to the report (page 3-1.3). This list has major headings pertaining to specific measurement areas such as critical waveguide bands or coaxial connector types. Subheadings define parameters in applicable areas.

Since the original publication of the NCSL Measurements Requirements Survey of 1983, very little progress has been made by the NBS to improve or develop new standards to meet the measurement needs of industry and military calibration agencies. Many DoD programs are currently in engineering development or have already proceeded in the qualification phases for full-scale production.

The MILSTAR Program is of major concern since NBS traceability is non-existing in many critical areas. This report makes the needed support the number one priority. The specific areas have been defined

INTRODUCTION (CONTINUED)

as impedance, low/high power, attenuation, noise temperature, antenna gain, and phase noise. Actual requirements for high power and phase noise have recently surfaced as better system definition has become known.

It is beyond the scope of this report to idendify detailed requirements of MILSTAR payloads, cummunication links, terminal hardware, and platforms since most of these are considered classified. However, with the proper clearance such information can be made available. Major Aerospace contractors and many subcontractors are pressing ahead with development of components, subsystems, and overall systems designs for the MILSTAR program. Availability of NBS standards will be a very critical issue as systems will soon be in an operational mode.

Standards for Seekers in WR-28 (26.5 to 40 GHz), Short Range Radars, and Guidance/Passive Systems at WR-10 (75 to 110 GHz) will require full band calibration services. These programs, now in engineering development phases, must have NBS traceability prior to full scale production.

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PRIORITIES

The following list provides some guidance to the priorities assigned to the parameters for this report. The highest priority is 1.) a.).

1.) WR-22 Band (33 to 50 GHz)
    a.) Impedance
    b.) Low Power (nominal 10 mW)
    c.) Noise Temperature
    d.) Attenuation
    e.) Phase Noise
    f.) Antenna Gain
    g.) High Power to 160 W
2.) Standards with 3.5 mm and 7 mm Connectors
    a.) Impedance
    b.) Power
    c.) Noise Temperature
    d.) Attenuation
3.) Four-Terminal Resistance & Capacitance Standards at 1, 10 MHz; Q from 10 kHz to 70 MHz.
4.) WR-28 Band (26.5 to 40 GHz) Noise Temperature.
5.) WR-10 Band (75 to 110 GHz), full band.
6.) High Power, 0.1 to 200W, 10MHz to 6GHz.
7.) High Power, 1 MHz to 2 GHz, up to 25 kW.
8.) Power Density to 100 mW/cm**2, 300 MHz to 26.5 GHz.

PARAMETER: IMPEDANCE/ADMITTANCE

UNITS: Volts/Volts

REQUIREMENTS

1.) Provide a measurement capability for one and two port 3.5 mm impedance standards over a frequency range of 45 MHz to 26.5 GHz. Reflection Coefficient range is 0.01 to 1.0 with a basic accuracy of +/- 0.002 to 0.01.
2.) Provide a measurement capability for One and Two Port Impedance Standards in WR-22 (33 to 50 GHz) band with a Reflection Coefficient range of 0.002 to 1.0 and a basic accuracy of +/- 0.001 to 0.005. The critical frequencies are 45-47 GHz.
3.) Same as 2.) above for WR-10 (75 to 110 GHz) band except full band is utilized.
4.) Certification of four-terminal resistance and capacitance standards used for testing the new generation of automatic RF bridges and impedance meters. The required test frequencies are 1 to 15 MHz. The resistance range is 0.1 ohms to 10K ohms with an accuracy of +/- 0.05 to 1 %. The capacitance range is 1 to 1000 pF with an accuracy of +/- 0.05 to 0.1 %.
5.) Dissipation factor readings at 1 and 10 MHz on RF capacitors ranging from 1 to 1000pF.

STATUS at NBS

1.) NO CAPABILITY. The calibration services for 3.5 mm devices to 26.5 GHz has been rescheduled from April 1986 to late 1986.
2.) NO CAPABILITY. The capability for WR-22 band has been rescheduled from April 1986 to late 1986.
3.) LIMITED CAPABILITY. No plans for WR-10 full band coverage.
4.) NO CAPABILITY. No plans for four terminal calibrations.
5.) NO CAPABILITY. Dissipation factor measurement capability being investigated at NBS/Gaithersburg.

INDUSTRIES AFFECTED

1.) Military calibration agencies
2.) Aerospace contractors
3.) Component manufacturers

PARAMETER: IMPEDANCE/ADMITTANCE (CONTINUED)

APPLICATION and IMPACT

1.) Support for calibration of Automatic Network Analyzer Systems used to acceptance test microwave components for the Trident II and the GPS W-Sensor Programs.
2.) WR-22 band capability is required to support the MILSTAR Uplink System and other developing systems.
3.) Seekers and Radar Guidance Systems such as STARTLE and other special programs.
4.) Four-terminals bridges are used to maintain quality control on RF components by both manufacturers and users. In many cases, testing to military specification is performed. It is not possible for calibration laboratories to support these bridges without NBS support.
5.) Same as 4.) above.

NEW REQUIREMENTS

None

SPECIAL COMMENTS

None

PARAMETER: Q-FACTOR

UNITS: Ratio

REQUIREMENTS

1.) Provide a measurement capability to support Q-Meter Standards. The frequency range is 10 KHz to 70 MHz, with an indicated "Q" of 5 to 1000 and an accuracy of +/- 3 to 5 %.

STATUS at NBS

1.) Existing capability covers most of the requested range at lower accuracies.

INDUSTRIES AFFECTED

1.) Aerospace Companies

APPLICATION and IMPACT

1.) Component acceptance testing on military programs.

NEW REQUIREMENTS

None

SPECIAL COMMENTS

1.) It is recommended that the NBS provide updated written material on how to utilize existing standards and measurement techniques in order to obtain consistent calibration results of various Q-Meters.
2.) Hewlett-Packard provides note 4342-5 for the evaluation of their Q meter, model 4342.

PARAMETER: LOW/HIGH POWER

UNITS: Watts

REQUIREMENTS

1.) Provide Effective Efficiency and Calibration Factor measurements for thermistor mounts and calorimeters in WR-22 (33 to 50 GHz) band. The nominal power is 1 to 100 mW with an accuracy 1 to 2 %. The critical frequencies are 44.5 to 47 GHz.
2.) Provide same capability as 1.) above for WR-10 (75 to 110 GHz). Full band capability is required.
3.) Provide Effective Efficiency and Calibration Factor measurements for 3.5 mm thermistor mounts and power sensors from 10 MHz to 26.5 GHz at nominal power levels from 0.1 to 100 mW and expected accuracy of +/- 0.5 to 1.5 %.
4.) Extend the power range down to 0.1 nW for Type N and 3.5 mm devices over a frequency range of 10 MHz to 18 GHz. The required accuracy is +/- 0.5 to 1.%.
5.) Establish capability for power standards operating at levels from 0.1 to 200 W between 10 MHz and 18 GHz. Required accuracy is +/- 1 to 5 %.
6.) Establish a capability for type N power standards from 0.1 mW to 1000 W over a frequency range of 10 MHz to 1.6 GHz. The required accuracy is +/- 1 to 3 %.
7.) Establish a capability for type N power standards from 100 mW to 25 KW over a frequency range of 1 MHz to 2 GHz. The required accuracy is +/- 0.5 to 2 %.

STATUS at NBS

1.) NO CAPABILITY. The capability for WR-22 band has been rescheduled from April 1986 to the end of 1986.
2.) LIMITED CAPABILITY. No plans for WR-10 full band coverage.
3.) NO CAPABILITY. The calibration services for 3.5 mm devices to 26.5 GHz has been rescheduled from April 1986 to the end of 1986.
4.) NO CAPABILITY. No plans to extend down to 0.1 nW.
5.) NO CAPABILITY. No plans for high power calibration capability.
6.) NO CAPABILITY. Same as 5 above.
7.) NO CAPABILITY. Same as 5 above.

A.) Unknown
B.) Unknown
C.) Unknown

PARAMETER: LOW/HIGH POWER (CONTINUED)

INDUSTRIES AFFECTED

1.) Military calibration agencies
2.) Private sector

APPLICATION and IMPACT

1.) WR-22 is required for support to the MILSTAR Uplink System and other developing systems for military use.

2.) Special programs have already developed or are currently designing systems at 75 to 110 GHz.

3.) Instruments and components with APC-3.5 connectors are starting to appear in significant quantities. Instrument manufacturers and their users cannot effectively test this equipment without accurate measuring equipment at this interface.

4.) Support to the GPS Systems which requires calibration at 1 nW level. Many instruments, such as spectrum analyzers, use low-level standards to establish a reference on the display. Accurate set-up of this reference requires a precision sensor operating in the -10 to -60 dBm range.

5.) Microwave communication systems use high-level sources operating in the range of 0.1 to 200 W. Telemetry systems on the Trident I and II Programs have transmitters that must be checked with an accurate power sensor to verify conformance to minimum requirements. Failure to have accurate standards has caused disputes with suppliers.

6.) Support to the TACAMO program which requires high-power calibration to the UHF frequencies.

7.) Checkout and alignment of high-power transmitters for military navigation and surveillance requires power standards capable of measuring levels to 25 KW. Support of tactical air and ground communication gear requires RF power measurement capability from 100 mW to 1000 watts.

NEW REQUIREMENTS

A.) The Navy EHF Satellite Communications terminal for MILSTAR Uplink frequency has a high power measurement requirement for shipboard, submarine, and shore terminals.

B.) Submarine EHF Antenna - 100 W transmit capability in the 43.5 to 45.5 GHz.

PARAMETER: LOW/HIGH POWER (CONTINUED)

NEW REQUIREMENTS (CONTINUED)

C.) High Power Amplifier - Output power of +25 to +52 dBm (0.316W to 158.5W; 43.5 to 45.5 GHz).

SPECIAL COMMENTS

None

PARAMETER: NOISE TEMPERATURE

UNITS: dB or K

REQUIREMENTS

1.) Provide service for gas-discharge noise standards in WR-42 (18 to 26.5 GHz) band. Nominal value is 16.1 dB with expected accuracy of +/- 0.1 dB. Critical frequency range is 20.7 GHz +/- 2.0 GHz.
2.) Same as above for WR-22 (33 to 50 GHz) band. Nominal value increases to 16.3 dB and critical frequency is 44.5 GHz +/- 2.0 GHz.
3.) Provide service for solid-state coaxial noise sources with 7 mm connectors from 10 MHz to 18 GHz and sources with 3.5 mm connectors from 10 MHz to 26.5 GHz. Nominal value is 15.5 dB and expected accuracy varies from +/- 0.1 to 0.3 dB.

STATUS at NBS

1.) LIMITED CAPABILITY. Calibration services are available at selected frequencies in WR-42 band.
2.) NO CAPABILITY. An interim calibration service for WR-22 band is expected at the end of 1986 with an accuracy of 0.1 to 0.2 dB. A calibration service with an accuracy of 0.05 to 010 dB is expected to be available within 2 to 3 years.
3.) NO CAPABILITY. Calibration services for full ranges are not expected in the foreseeable future. Services to 8 GHz are expected by the end of 1986.

INDUSTRIES AFFECTED

1.) Military calibration agencies
2.) Private sector

APPLICATION and IMPACT

1.) The downlink system for the MILSTAR program.
2.) The uplink system for the MILSTAR program.
3.) Low-noise amplifiers and mixers offered by several manufacturers for use in communication systems cannot be satisfactorily tested.

PARAMETER: NOISE TEMPERATURE (CONTINUED)

NEW REQUIREMENTS

None

SPECIAL COMMENTS

None

PARAMETER: ATTENUATION

UNITS: dB

REQUIREMENTS

1.) Provide service for waveguide devices in WR-22 (33 to 50 GHz) band with a range of 0 to 50 dB and a basic accuracy of 0.03 to 0.1 dB. The critical frequency is 44.5 GHz +/- 2.0 GHz.
2.) Provide the same service for WR-10 (75 to 110 GHz) band. Full band is utilized; reduced accuracy is acceptable.
3.) Provide calibration services on APC-3.5 attenuators to 26.5 GHz. Attenuation range is 0 to 50 dB with an accuracy of +/- 0.02 to 0.1 dB.

STATUS at NBS

1.) NO CAPABILITY. Calibration services for WR-22 has been rescheduled from April 1986 to late 1986.
2.) LIMITED CAPABILITY. No plans for WR-10 full band coverage.
3.) NO CAPABILITY. Calibration services for APC-3.5 attenuators has been rescheduled from April 1986 to late 1986.

INDUSTRIES AFFECTED

1.) Military calibration agencies
2.) Aerospace contractors

APPLICATION and IMPACT

1.) The Uplink system for the MILSTAR Program.
2.) Seekers and Radar Guidance Systems such as STARTLE and other special programs.
3.) Support for calibration of Automatic Network Analyzer Systems used to acceptance test microwave components for the Trident II and the GPS W-Sensor Programs.
4.) The Weinschel VM-4A and VM-24 are standards throughout all military calibration programs and are also widely used by aerospace and industrial companies.

NEW REQUIREMENTS

None

PARAMETER: ATTENUATION

SPECIAL COMMENTS

1.) NBS has developed services for VM4 accessories as requested in the original NMRC report.

PARAMETER: PHASE NOISE

UNITS: dBc/Hz

REQUIREMENTS

1.) No old requirements.

STATUS at NBS

A.) LIMITED CAPABILITY. Special Calibration services available at selected frequencies from 5 MHz to 100 MHz.

INDUSTRIES AFFECTED

1.) Military calibration agencies
2.) Aerospace contractors

APPLICATION and IMPACT

1.) 5 MHz. Required for support to the MILSTAR Airborne Terminal and Payload Master Frequency Oscillators.
2.) 70-80 MHz. Required for support to the MILSTAR Airborne Terminal Local Oscillator.
3.) 1.3 - 1.4 GHz. Required for support to the MILSTAR Airborne Terminal System.

PARAMETER: PHASE NOISE (CONINTUED)

APPLICATION and IMPACT (CONTINUED)

4.) 6.4 - 7.5 GHz. Required for support to the MILSTAR Airborne Terminal System.
5.) 42.5 - 46.5 GHz. Required for support to the MILSTAR Uplink System: Shipboard, Submarine, Shore Terminals.

NEW REQUIREMENTS

A.)

FREQ. RANGE, GHz	OFFSET F (Hz)									
	1	10	100	1K	10K	100K	1M	10M	100M	1G
.005	-112	-125	-145	-155	-165					
.065 - .080			- 95	-105	-115	-130	-130	-130		
1.3 - 1.4			- 88	-100	-110	-115	-135	-135	-135	
6.4 - 7.5			- 70	- 80	- 93	-113	-120	-120	-120	-120
42.5 - 46.5			- 59	- 71	- 81	- 86	-106	-106	-106	-106

Note: The negative figures in the table represent the phase noise component defined in terms of Decibel below Carrier per Hz. Abbreviated as dBc/Hz.

SPECIAL COMMENTS

None

PARAMETER: ANTENNA GAIN

UNITS: dB

REQUIREMENTS

1.) Provide antenna gain measurements for standard gain horns in WR-22 (33 to 50 GHz) band. Nominal value is 24 dB with expected accuracy of +/- 0.1 dB. Critical frequency is 44.5 GHz +/- 2.0 GHz.

STATUS at NBS

1.) NO CAPABILITY. Calibration service is expected to be available at the end of 1987.

INDUSTRIES AFFECTED

1.) Aerospace contractors
2.) Military calibration agencies

APPLICATION and IMPACT

1.) MILSTAR contractors have been directed by the DoD to develop a program for antenna gain measurements.

NEW REQUIREMENTS

None

SPECIAL COMMENTS

None

PARAMETER: POWER DENSITY

UNITS: watts/area

REQUIREMENTS

1.) Survey the meter probes used in monitoring the antenna radiation over the frequency range of 100 kHz to 26.5 GHz. The power density range is from 0.1 to 100mW/cm**2 with an accuracy of +/- 0.5 dB.

STATUS at NBS

1.) LIMITED CAPABILITY. The current calibration service is to 1 GHz at a power density of 10mW/cm**2. No plans to provide calibration services to 26.5 GHz in the foreseeable future.

INDUSTRIES AFFECTED

1.) Military calibration agencies
2.) Private sector

APPLICATION and IMPACT

1.) OSHA regulation makes it necessary to verify that microwave radiation levels in work areas are safe, e.g. radar antenna system radiation pattern at the antenna test sites and on shipboard.

NEW REQUIREMENTS

None

SPECIAL COMMENTS

None

SUBCOMMITTEE III: ELECTRO - OPTICS

CATEGORIES:

Radiometry/Photometry Technology
Laser Technology
Fiber Optic System Technology

INTRODUCTION:

Since the original report was prepared in 1982, this subcommittee has been reorganized. Some of the former committee members are still active with this requirement activity and are therefore listed as such. In addition, several new members have been added. The NBS "Consultants" were approached to ensure correctness of the statements in the parameter lists and to provide the required input for the NBS status of items identified as needing national attention.

The following pages show the committee's concern in regard to the 3 groups of Radiometry/Photometry Technology, Laser Technology, and Fiber Optics System Technology. All parameters are listed in alphabetical order within each of the 3 groups. Within each parameter, the requirements are listed in order of priority.

Overall, there are several critical parameters that industry is pushing for near term action or solution. Clearly not all can be given equal attention by the NBS but perhaps alternate solutions and/or recommendations can be proposed by the Bureau (certifying an industrial or university laboratory for specific items, e.g. Bennett's at China Lake for diffuse reflectance standards.)

Classifying the provided parameters by priority turned out to be an impossible task. Due to the diverse background of the subcommittee members, too many different projects were considered important for different reasons. There remained 3 items, however, that warrant further emphasis in terms of priority:

1.) Ambient and Cryogenic Blackbodies

Because of the exploding demand in electro-optics as well as precision thermometry, high accuracy blackbodies are required for several temperature ranges. Support by the NBS in this area is considered essential.

INTRODUCTION (CONTINUED):

2.) Laser Beam Profile

The need for exact beam profile measurements has become apparent for application in programs such as laser fusion, material science, and aerospace. An increased effort by the NBS in this area is recommended very highly.

3.) Optical Fiber Power Meters

The availability of high accuracy optical fiber power meters is required for almost all industries utilizing lasers of various nature. Results of the round robin and perhaps other (future) such programs should be utilized to recommend better instruments and standards.

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The following pages list the requirements identified for the category:

RADIOMETRY/PHOTOMETRY TECHNOLOGY

PARAMETER: AMBIENT TEMPERATURE BLACKBODY

UNITS: Kelvin (K)

REQUIREMENTS:

1.) Radiance temperature from 200 to 1200 K with accuracies of +/- 0.02 K for 200 to 400 K and +/- 0.05 K for temperatures >400 K. Ambient background.

STATUS at NBS:

1.) Capability exists from ambient to 1200 K with accuracy of +/- 0.5 K.

  a.) -40 to +40 degrees C +/- 0.2 degrees C abs., +/- 0.05 degrees C temperature difference. (True Ambient Blackbody)

  b.) Ambient to gold point +/- 0.5 to 1.0% radiance for specified wavelength, lambda. (Spectral Radiance)

A.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Department of Defense

APPLICATION and IMPACT:

1.) Radiation source for testing IR devices such as Imagers and Forward Looking Infrared Systems (FLIRS).
2.) Research and defense related programs.

NEW REQUIREMENTS:

A.) Temperature difference from 278 to 318 K with accuracy of ± 0.1%

SPECIAL COMMENTS:

1.) Eventually accuracies of +/- 0.005 K are required for radiance temperature measurements.

PARAMETER: CRYOGENIC BLACKBODY CALIBRATION

UNITS: Kelvin (K)

REQUIREMENTS:

1.) Radiance temperature (20 K background) from 100 to 500 K with accuracy of < 1.0 K.

STATUS at NBS:

1.) Will be reestablished in the future (budget has been approved, several years for construction and implementation are required).

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Department of Defense

APPLICATION and IMPACT:

1.) IR radiation source for testing IR detecting/imaging devices.
2.) Research and defense related programs.

NEW REQUIREMENTS:

None

SPECIAL COMMENTS:

1.) While constructing the in-house capability, NBS is investigating the use of alternate facilities to be utilized by NBS personnel in support of industry and government agencies needs.

PARAMETER: DETECTOR SPECTRAL RESPONSE

UNITS: Amperes/Watt

REQUIREMENTS:

1.) Silicon detector absolute response (A/W) for 200 to 1064 nm with accuracy of < 5.%.

STATUS at NBS:

1.) Detector Transfer Response Intercomparison Package (DTRIP or DRIP):

250 - 390 nm at +/- 6.0%; 400 - 490 nm at +/- 2.0%;
500 - 850 nm at +/- 1.0%; 860 - 960 nm at +/- 2.0%;
1014 nm at +/- 5.0%; 1064 nm at +/- 10.0%.

A.) Unknown
B.) Unknown
C.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Department of Defense
3.) Fiber Optic Communications Industry

APPLICATION and IMPACT:

1.) Laser Power Measurement - Visible, NIR
2.) Photometric Measurements
3.) UV Power Measurements
4.) Fiber Optics

NEW REQUIREMENTS:

A.) Better accuracy from 1.0 to 1.6 um (+/- 1%).
B.) Better accuracy for 10.6 um (+/- 1%).
C.) Power measurements up to 6 mW for the mercury lines of 254 and 365 nm (i.e. UV region).

PARAMETER: DETECTOR SPECTRAL RESPONSE (CONTINUED)

SPECIAL COMMENTS:

1.) Note: 100% quantum efficient detector (380-900 nm) available commercially with +/- 0.001% of absolute. Edward F. Zalewski and C. Richard Duda: Silicon Photodiode Device with 100% External Quantum Efficiency, Applied Optics, Vol. 22, Page 2867, September 15, 1983, Optical Society of America.

PARAMETER: FTIR SPECTROPHOTOMETER PHOTOMETRIC SCALE CALIBRATION STANDARDS

UNITS: Percent Transmission

REQUIREMENTS:

1.) Percent transmission for wavelength (lambda) = 1 to 40 um, range 0 to 100% transmission, accuracy < 1.%.

STATUS at NBS:

1.) Development work for two systems are in progress for 2 to 25 um with accuracies of 1 to 3 %.

  a.) Dispersive system: Will provide benchmarks up to 50 um.
  b.) FTIR system: Will be operating in the scanning mode for up to 25 um.

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Biological Industry
3.) Chemical Industry
4.) Department of Defense
5.) Forensic Medical Industry

APPLICATION and IMPACT:

1.) Determining infrared absorption transmission characteristics of various substances and optical components.
2.) Test and characterization of IR components such as Ge, Si lenses,etc..
3.) Research related programs - optical components.

NEW REQUIREMENTS:

None

SPECIAL COMMENTS:

1.) Possible use of neutral density filters as SRM's. Various materials under investigation by NBS personnel.

PARAMETER: IR WINDOW and FILTER TRANSMISSION

UNITS: Percent Transmission

REQUIREMENTS:

1.) Percent transmission (measurement environment 20 to 300K) in the range of 0 to 100 % transmission, % transmission accuracy < 1%T for lambda 1 to 40 um.

STATUS at NBS:

1.) Research in progress. One to one and a half (1 to 1 1/2) years before implementation.

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Defense

APPLICATION and IMPACT:

1.) Component testing of optical test systems for IR sensors/ detectors such as lenses, etc..

NEW REQUIREMENTS:

None

SPECIAL COMMENTS:

None

PARAMETER: REFLECTANCE (DIFFUSE)

UNITS: Ratio

REQUIREMENTS:

1.) Diffuse Reflectance Standards for 1.06 um (Nd;YAG) and 10.6 um (CO2) at accuracies of +/- 1%.

STATUS at NBS:

1.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Department of Defense

APPLICATION and IMPACT:

1.) Light Detecting and Ranging (LIDAR)
2.) Material Surface Analysis

NEW REQUIREMENTS:

None

SPECIAL COMMENTS:

1.) Flame sprayed Aluminum is not stable enough. Require a real standard. Research available in the commercial sector.

PARAMETER: REFLECTANCE (SPECULAR)

UNITS: Ratio

REQUIREMENTS:

1.) Specular reflectance for 0.27 to 30 um with an accuracy of +/- 0.001 reflectance units.

STATUS at NBS:

1.) Research in progress. One to one and a half (1 to 1 1/2) years before implementation.

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Department of Defense
3.) Material Science Industry

APPLICATION and IMPACT:

1.) Optical component testing
2.) Light Detecting and Ranging (LIDAR)
3.) Material Property Analysis

NEW REQUIREMENTS:

None

SPECIAL COMMENTS:

1.) Specular Reflectance to at least 10.6 um (CO2) required at specific angles of incidence/reflection. Combine with current NBS effort on "Scratch and Dig" samples for surface texture.

The following pages list the requirements identified for the category:

LASER TECHNOLOGY

PARAMETER: LASER BEAM PROFILE

UNITS: Power Density Ratio

REQUIREMENTS:

1.) No old requirements.

STATUS at NBS:

A.) Some work is being conducted primarily at 1.064 and 10.6 um. NBS has promised laser beam profile standards and measurement service contingent on funding.

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Department of Defense
3.) Laser Fusion Research
4.) Material Science Industry
5.) Manufacturing, etc.

Almost all users of lasers could benefit from this.

APPLICATION and IMPACT:

1.) Pulsed Laser profiles - beam shaping.
2.) Measurements are critical to both strategic and tactical laser device performance. Development of national standards and uniform techniques could save program development costs.
3.) Critical to communication application for information fidelity.

NEW REQUIREMENTS:

A.) Laser profile characteristics for all ranges. National Standards are required for both beam uniformity and divergence measurements. All mode properties of the beam need to be measured.

SPECIAL COMMENTS:

1.) Phase information combined with profiles can be used to extract mode content. Some commercial work is being done in this area, e.g. Spiricon, Zygo, Wyco.

PARAMETER: LASER MODE EVALUATION

UNITS: Ratio

REQUIREMENTS:

1.) No old requirements.

STATUS at NBS:

A.) Some work in conjunction with profile measurements has been undertaken.

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Department of Defense
3.) Fiber Optic Test Equipment Industry
4.) Medical Industry
5.) Optical Fiber Communication Industry

APPLICATION and IMPACT:

1.) Knowledge of Mode Structure is necessary for prediction of power density in focused beam and power profile in the focal plane. Mode structure determines the fraction of launched power captured by an optical fiber.

NEW REQUIREMENTS:

A.) Mode (TEM) for all ranges but especially at 1.064 and 10.6 um at high accuracies. (See page 4-11 also.)

SPECIAL COMMENTS:

1.) Simple power measurement is insufficient to know what mode a laser or laser diode is in.

PARAMETER: LASER POWER/ENERGY (CONTINUED)

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Agriculture Industry
3.) Civil Engineering
4.) Department of Defense
5.) Machining
6.) Medical Industry
7.) Laser Fusion Research

APPLICATION AND IMPACT:

1.) Laser applications are becoming much more common and hence the need for calibration support is rapidly growing. The experience NBS has gained should be shared with the measurement community in order to minimize errors and to limit duplication of much of the effort that has already been expended.

2.) Laser welding reliability and cutting accuracy suffer if power measurements are inaccurate. Surgical applications require known power levels. Power/energy at any frequency need to be traceable to National Standards.

3.) Accuracies at low energy levels are required for laser tracking and laser target acquisition.

NEW REQUIREMENTS:

A.) Energy calibrations at 400 nm with calibration accuracies of less or equal to +/- 3.% from 1 to 10 mjoules.

B.) Establish semiconductor wavelength standards in the bands interesting for fiber optics application; 700-900 and 1300-1550 nm. The accuracy of transfer standards should be approximately ±0.2% below 1 u watt.

SPECIAL COMMENTS:

1.) NBS needs to develop broader and more flexible wavelength coverage in power/energy calibration and to extend the scale at both the low and the high power/energy end.

2.) In the future the wavelength range should be continuous from 0.19 to 25. micros.

PARAMETER: LASER POWER/ENERGY

UNITS: Watts/Joules

REQUIREMENTS:

1.) Lasers/Wavelengths - Ultraviolet (ArF at 193 nm) to 15 microns (Nd:YAG, 1.064 microns; DF,3.5-3.8 microns; CO, 10.6 microns; tuneable infrared laser system 2-15 microns).

2.) Laser Power/Energy - from near photon limit of 10**-17 joules at 1.064 microns to multi-kilojoule (pulsed) and megawatt (CW).

At low and moderate energies the required accuracies are:

Wavelength	Energy	Accuracy
1.064 microns	0.1-10. femtojoules	+/- 3.%
" "	1.0 nanojoules	+/- 3.%

STATUS AT NBS:

1.) NBS is working on a broad spectrum of standards between 10**-9 and 10**3 joules/pulse covering the 0.25 to 15. micron spectral range. It is unclear when these will become available.

Calibration support in UV and IR is "hampered" by the fact that at present the lasers in the calibration system cover the visible, 1.064 microns, and 10.6 microns. NBS has no power/-energy calibration facility in the UV or in the IR range away from Nd:YAG and carbon dioxide.

2.) Transfer standard characterized to 5 kilowatts at 10.6 microns exists and can be characterized at 1.06 microns at high power if requests are made directly to NBS. One femtojoule transfer standards are available at 1.06 microns. Accuracies of +/- 3.% are available at 1.064 microns from 10. mjoules to 1. joule. Below 10. mjoules accuracies of +/- 5.% are available.

A.) Unknown

B.) Unknown

PARAMETER: LASER ATTENUATION

UNITS: Ratio

REQUIREMENTS:

1.) No former requirements.

STATUS at NBS:

A.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace Industy
2.) Test and Measurement

APPLICATION and IMPACT:

1.) Ability to put known loss into laser system.

NEW REQUIREMENTS:

A.) Large value of attenuation standards analogous to RF step attenuators; 0-70 dB +/- 0.5 dB.

SPECIAL COMMENTS:

None

PARAMETER: LASER POINTING and TRACKING

UNITS: Radians

REQUIREMENTS:

1.) No old requirements.

STATUS at NBS:

A.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Communication Industry
3.) Department of Defense

APPLICATION and IMPACT:

1.) Pointing and tracking of communication satellites. Define the angles of Laser/Fiber gyroscopes (ring type).

NEW REQUIREMENTS:

A.) Angle range: 1-10 microradians
imprecision +/-0.3 microradians
resolution 0.1 microradians

10-100 microradians
imprecision +/- 3. microradians
resolution 1. microradian

SPECIAL COMMENTS:

None

The following pages list the requirements identified for the category:

FIBER OPTICS

PARAMETER: OPTICAL FIBER CHARACTERISTICS

REQUIREMENTS:

1.) No old requirements.

STATUS at NBS:

A.) Unknown
B.) Unknown
C.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Department of Defense
3.) Telecommunications Industry

APPLICATION and IMPACT:

1.) Test and calibration of fiber optic test equipment.

NEW REQUIREMENTS:

A.) Chromatic Dispersion (single mode).
B.) Development of fiberoptic connector characterization.
C.) Near and far field pattern (numerical aperture).

SPECIAL COMMENTS:

None

PARAMETER: OPTICAL POWER METERS

UNITS: Watts, Joules

REQUIREMENTS:

1.) Calibration of single mode and multimode optical fiber power meters in all three optical fiber "windows" (850, 1300, and 1550nm) from 0.01 nW to 100.mW at ± 1.% accuracy.

STATUS at NBS:

1.) NBS has some capability of 850 nm (multimode) and 1300 nm (single mode) optical power meter calibration.

A.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Department of Defense
3.) Telecommunications Industry

APPLICATION and IMPACT:

1.) Test, evaluation, and calibration of optical power meters used in the design, manufacture, and maintenance of fiber-optic data and communication systems.

NEW REQUIREMENTS:

A.) 1550 nm single mode power meter calibration.

SPECIAL COMMENTS:

1.) The results of a round robin test conducted by NBS indicated an unreasonable large variation in power meter readings taken at different laboratories.
2.) NBS will not provide total uncertainty with report of calibration for power at 1300 and 1550 nm wavelengths.

PARAMETER: OPTICAL POWER METERS (CONTINUED)

SPECIAL COMMENTS (CONTINUED):

3.) Standardized method for calibration of optical power meters and detectors is required; defining light source wavelength, bandwidth of <10 nm, and type of coupling to the detector such as fiber core 50 um diameter.

4.) Calibration of power meters and detector standards should be at stated power levels from >10 uW to <100 uW with 100 uW preferred.

PARAMETER: OPTICAL TIME DOMAIN REFLECTOMETER CALIBRATION (OTDR)

REQUIREMENTS:

1.) Calibration for both single mode and multimode long-haul and local area network OTDR's:

    a.) Temporal Resolution: ± 100 ps
    b.) Attenuation Range: 0 to 20 dB
    c.) Attenuation Accuracy: ± 0.04 dB from 0 to 10 dB
                                                  ± 0.08 dB from 10 to 20 dB

STATUS at NBS:

1.) NBS can provide a test fixture for 850 nm (multimode) long-haul OTDR's. Research is in progress for single mode, long-haul calibrators (1300 and 1550 nm).

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Department of Defense
3.) Telecommunications Industry

APPLICATION and IMPACT:

1.) Test, evaluation, and calibration of OTDR's.

NEW REQUIREMENTS:

None

SPECIAL COMMENTS:

1.) OTDR's with resolutions of less than 1 centimeter are now available. NBS needs to develop calibration standards and techniques to verify performance.

PARAMETER: DETECTOR SPECTRAL RESPONSE
(Fiber Optic Communication Use)

UNITS: Amperes/ Watts

REQUIREMENTS:

1.) Silicon detector absolute response (A/W) for 850nm with accuracy of +/- 1.0%.
2.) Long wavelength detector absolute response (A/W) for 1300 and 1550 nm at +/- 1.0%.

STATUS at NBS:

1.) Silicon detector transfer response intercomparison package (DTRIP) covers the requirement at 850 nm wavelength. (See also page 4-5).
2.) Calibration of detectors around 1300 nm with no statement of uncertainty is available from NBS.

A.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Department of Defense
3.) Fiber Optic Communication Industry

APPLICATION and IMPACT:

1.) Test, evaluation, calibration of fiber optic test equipment.
2.) Correlation of U.S. and foreign optical communication power measurements.

NEW REQUIREMENTS:

A.) Detector absolute response (A/W) for 1550 nm with accuracy +/- 1.%.

PARAMETER: DETECTOR SPECTRAL RESPONSE (CONTINUED)

SPECIAL COMMENTS:

1.) NBS should provide report of calibration stating total uncertainty for responsivity (A/W), power applied (uW), photo current (uA), wavelength of calibration source, bandwidth (nm) of calibration source.

2.) NBS method of calibration should be compatible with use of the detectors in the fiber optic communication industry, such as using 50 um fiber to couple the power to the detector, calibration light source of 5-10nm bandwidth (laser diode source suggested).

3.) NBS furnished T.E. cooled detector and electronics package with data (such as "DRIPT" package) would be useful for the 1300 to 1550 nm wavelengths.

PARAMETER: FIBER OPTIC ATTENUATORS

UNITS: dB

REQUIREMENTS:

1.) No old requirements.

STATUS at NBS:

A.) Unknown
B.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Department of Defense
3.) Telecommunications Industry

APPLICATION and IMPACT:

1.) Test and calibration of Fiber Optic Test Equipment.

NEW REQUIREMENTS:

A.) Calibration of N.D. filter and wedge type Fiber Optical Attenuators at 850, 1300, and 1550 nm in 10 dB steps from 0 to 60 dB. Accuracies of +/- 0.1 dB.
B.) Calibration of variable Fiber Optic Attenuators in the range of 0-80 dB at 850nm, 0-70 dB at 1300nm, and 0-50 dB at 1550 nm. Accuracies of +/- 0.1 dB/10 dB step and resolution of 0.01 dB.

SPECIAL COMMENTS:

None

PARAMETER: OPTICAL FIBER LOCAL AREA NETWORK

REQUIREMENTS:

1.) No former requirements.

STATUS at NBS:

A.) NBS has initiated some work in this area.

INDUSTRIES AFFECTED:

1.) Aerospace Industry
2.) Department Defense
3.) Telecommunications Industry

APPLICATION and IMPACT:

1.) New standards and measurement techniques will most likely be needed for the test, evaluation, and maintenance of optical fiber local area networks.

NEW REQUIREMENTS:

A.) Standards for optical fiber local area networks (whatever the standards might be).

SPECIAL COMMENTS:

1.) In short-haul (LAN) applications, the increase in component count (connectors, couplers,etc.) make the performance characteristics of these components and their interactions more critical than the fiber's.

SUBCOMMITTEE IV: TEMPERATURE - PRESSURE

CATEGORIES:

- Electrolytic Conductivity
- Flow (Gas)
- Flow (Liquid)
- Heat Flux
- Leak Rate (Gas)
- Pressure
- Temperature
- Thermal Conductivity
- Vacuum

INTRODUCTION

This subcommittee was reorganized after submission of the original report in 1982. Some of the original members are still active and others have been added; primarily to expand the coverage and to include representatives from a more diverse background. The NBS "Consultants" provided valuable information concerning the needs of industries not canvassed by the committee membership and the potential for future NBS activities.

The scope of the disciplines surveyed by this subcommittee complicate the task of spotlighting significant problems that require more priority than others; nevertheless, there are measurement areas that have a potential for impact that should be considered in NBS plans. In each of the parameters, the more significant problem is listed first and the relevance of the need is briefly discussed in the application and impact section. New requirements may be deemed to have significance; if so, the importance is discussed where this need is identified.

The relative importance of the need between parameters is not identified for this subcommittee's discussion because their interplay cannot be correlated. Among the items listed there are several that are considered extremly important to warrant special mention. These are listed below with a short description of the problem and its relevance:

1.) Electrolytic Conductivity-Conductance Standards Documentation

The pharmaceutical industry is the principal area of application and need for electrical conductivity measurements. It indicated a need for clarification/documentation regarding the use of these standards and for sources of standards materials (SRM's) that may be used. The need exists in the industry for the preparation of fluids based upon water that must evidence "high" purity level. Low level standards are desired.

INTRODUCTION (CONTINUED)

2.) Temperature-Optical Fiber Thermometry. High Temperature Freezing Points

Improvements in accuracy that may be provided by the development of optical fiber thermometry and by the further development of high temperature freezing points (e.g. Palladium, Rhodium, Iridium, etc.) have been identified as crucial for continuing development of high temperature blackbodies. Primarily in aerospace, but also in other industries, the precision of high temperature measurements relates to the yield and reproducibility of processes. New technology, requiring the use of blackbodies to calibrate optical sensing devices, is creating further needs to accurately define high temperature measurements.

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PARAMETER: ELECTROLYTIC CONDUCTIVITY

UNITS: Siemens/cm (mho, 1./ohm)

REQUIREMENTS:

1.) Conductance Standards as SRM's.
2.) Documentation/programs to assure commonality in measurement technology.

STATUS at NBS:

1.) A feasibility study was under way in 1984 to investigate aqueous conductance standards as SRM's.
2.) No progress has been reported for the documentation or the SRM's.

A.) Unknown

INDUSTRIES AFFECTED:

1.) Electronic
2.) Medical
3.) Pharmaceutical
4.) Power

APPLICATION and IMPACT:

1.) Pharmaceutical: Purity of fluids based upon water is critical.
2.) Electronic: Cleaning and processing at all levels of manufacturing requires pure, low conductivity water.
3.) Environmental issues, oceanography, health related issues, etc., depend upon the quality of fluids used for standards.

NEW REQUIREMENTS:

A.) Techniques for measuring the parameter need to be refined.

SPECIAL COMMENTS:

None

PARAMETER: LIQUID and GAS FLOW

UNITS: (volume or mass/time)

REQUIREMENTS:

1.) Measurement Assurance Program (MAP)
2.) Documentation
3.) Liquid flow calibration to 300 GPM with +/- 0.025% accuracy.
4.) Gas flow calibration from 1 to 50,000 SCIM with +/- 0.1% accuracy.
5.) Steam Flow calibration.

STATUS at NBS:

1.) Laboratory intercomparisons have been arranged by NBS; however, MAP's are not available. Round Robin will start within the near future (i.e. late 1986).
2.) Documentation is available for data essential to flowmetering; additional efforts are underway to expand the documentation available. Recent publications are:

    a.) "Fluid Metering Research at NBS", C.I. 84-R767
    b.) "Workshop on Fundamental Research-Issues in Orifice Metering", GRI-84/0190

3.) Present liquid flow accuracy is +/- 0.1%. Efforts underway to upgrade the facilities may result in improved accuracy. Primary objectives are to improve turnaround and lessen costs.
4.) Plans are under way to improve accuracy from 0.2 to 0.1% i.v..
5.) There are no plans to develop a capability for steam flow.

A.) Unknown
B.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Chemical
3.) Medical
4.) Petroleum
5.) Pharmaceutical
6.) Power
7.) Defense

PARAMETER: LIQUID and GAS FLOW (CONTINUED)

APPLICATION and IMPACT:

1.) Fluid flow measurements are fundamental to the control of processes in many industries. Their quality has direct affects upon the costs associated with product sales and can offset the performance of products.

NEW REQUIREMENTS:

A.) Multi-Phase Flow
B.) Cryogenic Flow

SPECIAL COMMENTS:

1.) Solid-liquid flow (multiphase) calibration facilities are currently being developed at NBS. Services to be offered will be unique in the U.S..

PARAMETER: PRESSURE

UNITS: kilopascals/m**2 (psi)

REQUIREMENTS:

1.) Calibration of gas piston gages for P > 600 psi.
2.) Calibration of gas piston gages for P < 600 psi.
3.) Calibration of oil piston gages for 4000 to 40,000 psi.

STATUS at NBS:

1.) No calibration service offered. Plans were made to implement a service by 1985 with +/- 30 ppm accuracy capability but have not been implemented.
2.) Service is available at 50 ppm accuracy.
3.) Service is available to +/- 75 ppm accuracy with no further improvement planned.

A.) Unknown
B.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Chemical
3.) Medical
4.) Petroleum
5.) Pharmaceutical
6.) Power, etc.

APPLICATION and IMPACT:

1.) Pressure measurements are an integral part of the controls of many processes wherein the precision directly affects the quality and quantity of the product.

NEW REQUIREMENTS:

A.) Pressure calibration above 40,000 psi up to and above 200,000 psi.
B.) Dynamic pressure measurement to the region of 1000 Hz. Pressure levels can be > 200,000 psi.

PARAMETER: PRESSURE (CONTINUED)

NEW REQUIREMENTS (CONTINUED):

C.) Pressure measurements to support calibration of manometers or similar devices used to calibrate "Air Data" instrumentation used in the aircraft and allied industries. Station barometers used by air transportation facilities would also fall into this category.

SPECIAL COMMENTS

None

PARAMETER: TEMPERATURE

UNITS: Kelvin (K), Centigrade (degrees C), Fahrenheit (degrees F)

REQUIREMENTS:

1.) 2 < T < 273 K: Cryogenic range, fixed point cells, calibration of interpolating devices such as RhFe, Germanium, Platinum, etc..
2.) 273 < T < 473 K: Biological range, fixed points cells such as Gallium, Rubidium, Indium, and Succinonitrile are needed to more uniquely define the range for thermometer calibrations.
3.) 273 < T < 1200 K: Instrumentation with higher accuracy than thermocouples is needed.
4.) MAP: Additional MAP's for thermocouples and low temperature devices are needed.
5.) T > 1200 K: Instrumentation with higher accuracy than thermocouples is needed.

STATUS at NBS:

1.) In addition to the established calibrations for Platinum, Germanium, and RhFe thermometers, fixed points such as the triple point of Argon may be calibrated at the NBS.
2.) SRM's for Gallium, Rubidium, Succinonitrile are available. New SRM's are being developed.
3.) NBS has an ongoing project to develop a high temperature Platinum Resistor Thermometer (up to 1064 degrees C).
4.) MAP's are curtailed.
5.) Higher Accuracy thermocouples and optical fiber techniques are being studied.

A.) Unknown
B.) Unknown
C.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Chemical
3.) Medical
4.) Petroleum
5.) Pharmaceutical
6.) Power
7.) Steel, etc

PARAMETER: TEMPERATURE (CONTINUED)

APPLICATION and IMPACT:

1.) The needs for fixed points in temperature calibrations are based upon many industries. The lower temperature points (cryogenic region) are to support the fabrication of solid-state devices used as detectors; the mid-range for the medical/pharmaceutical industry for sterilization and production of products; the higher temperatures for furnaces used to calibrate and test optical pyrometers, etc. and also for the production of metal alloys.

NEW REQUIREMENTS:

A.) Optical fiber thermometry, above 1337 K, calibration techniques.

B.) Freezing points above the Copper point (i.e. Palladium, Rhodium, Iridium). Needs exist for up to 2500 degrees C fixed points.

C.) Reliable SRM's (Strip Lamps) for radiation thermometry temperatures up to and above 2300 degrees C.

D.) Temperature measurements to 2000 degrees C using other than optical techniques, e.g. Tungsten-Rhenium thermocouples.

SPECIAL COMMENTS:

None

PARAMETER: THERMAL CONDUCTIVITY - HEAT FLUX

UNITS: W/m*K and cal/sec*cm**2

REQUIREMENTS:

1.) Broaden the range of SRM's for insulating materials.
2.) Additional low conductivity solid SRM's.

STATUS at NBS:

1.) NBS is actively working on cooperative programs with DOE and other agencies within the Department of Commerce to develop standards of high and low density fiber materials for dissemation as SRM's.
2.) Two tungsten and three graphite conductivity standards are available as SRM's.

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Chemical
3.) Home Appliance
4.) Home Construction
5.) Medical
6.) Micro-Electronic
7.) Pharmaceutical
8.) Plastic
9.) Power
10.) Steel

APPLICATION and IMPACT:

1.) The most significant impact lies in the Home Construction and Commercial Construction industries where the environmental and energy conservation criteria drive the design factors. Reference: "The National Plan for the Thermal Performance of Building Envelope Systems and Materials", ORNL/Sub-7973/1, dated March 1982. (Available from National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.)

NEW REQUIREMENTS:

None

PARAMETER: THERMAL CONDUCTIVITY - HEAT FLUX (CONTINUED)

SPECIAL COMMENTS:

None

PARAMETER: VACUUM (CONTINUED)

NEW REQUIREMENTS:

A.) Mass Spectrometer Calibration: 1-100 emu, sensitivity +/- 5.% for partial pressure to 10**-10 Torr.

SPECIAL COMMENTS:

None

PARAMETER: VACUUM

UNITS: pascal (torr, mm-Hg, N/m**2, in-Hg, millibar)

REQUIREMENTS:

1.) Ion gage calibration: 10**-3 to 10**-6 Torr to accuracies of +/- 0.5%.
2.) Spinning rotor gage calibration: 10**-3 to 10**-6 Torr to accuracies of +/- 1.%.
3.) Calibration to 10**-8 Torr.

STATUS at NBS:

1.) Service is available but not to required accuracies.
2.) Service is available. Studies under way to extend range to 10**-1 Torr and accuracy to 1. to 2. %.
3.) Depending upon the leak program, some standards in pressure below 10**-6 Torr may be available by late 1986.

A.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Chemical
3.) Home Appliance
4.) Petroleum
5.) Pharmaceutical
6.) Power

APPLICATION and IMPACT:

1.) Pressure measurements in the medium to high vacuum areas affects many industries in that process yields depend upon reproducible conditions to be consistent.
2.) Manometry, an area of measurement that overlaps to the "pressure" discipline, is important because of the air-transportation industry. Manometers used to calibrate flight instrumentation must be improved because of the precision needed in altitude separation, terrain clearance, etc.

PARAMETER: VACUUM - LEAK RATE (CONTINUED)

SPECIAL COMMENTS:

None

PARAMETER: VACUUM - LEAK RATE

UNITS: moles/sec (std-cc/sec, oz/yr, micron-ft**3/hr, etc.)

REQUIREMENTS:

1.) Helium leak rate standards (permeation) for 10**-3 to 10**-8 std-cc/sec with an uncertainty of +/- 5.%.

STATUS at NBS:

1.) A program is staffed and has been under way for in excess of one year to establish the capability.

A.) Unknown
B.) Unknown
C.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Electronic
3.) Home Appliance
4.) Medical
5.) Pharmaceutical
6.) Power

APPLICATION and IMPACT:

1.) For all industries, the leakage of encapsulated or sealed items affects the usable life cycle. Leakage of containments can affect the environment, i.e. power industry.

NEW REQUIREMENTS:

A.) Extend the calibration capability for Helium permeation leak rate standards from 10**-8 to 10**-12 std-cc/sec.
B.) Additional capability for capillary or similar leak rate standards for other gases such as Argon, Hydrogen, Neon, etc., from 10**-3 to 10**-8 std-cc/sec with comparable accuracy.
C.) Extend the calibration capability for capillary type leaks from 10**-3 to 10**-1 cr greater std-cc/sec to include a capability for halogen gases.

SUBCOMMITTEE V: PHYSICAL - DIMENSIONAL

CATEGORIES:

- Acceleration/Shock
- Acoustics
- Dimensional (Co-ordinate Machines)
- Dimensional (Gage Block)
- Force
- Hardness
- Hydrometry
- Hygrometry
- Mass
- Optics (Autocollimater)
- Particle Standards
- Particulate Properties
- Surface Finish (Roughness)

INTRODUCTION

The object of this report is to update information submitted on the original 1983 NCSL National Measurement Requirements survey compiled for Physical/Dimensional Standards.

Since the original survey was compiled, this committee has been re-organized twice. None of the original members are presently active. The most recent committee chairman had previously compiled some information on the standards which has been incorporated in this report.

Most of the parameters were covered by the new committee in a very short time frame. Therefore, there is a good possibility that some new categories still exist which are not mentioned in this report or that some requirements exist in addition to those mentioned here. For each of the parameters compiled, an effort was made to verify the contents with NBS consultants.

No clear distinction in terms of priority could be established. The parameters are listed in alphabetical order and not by priority.

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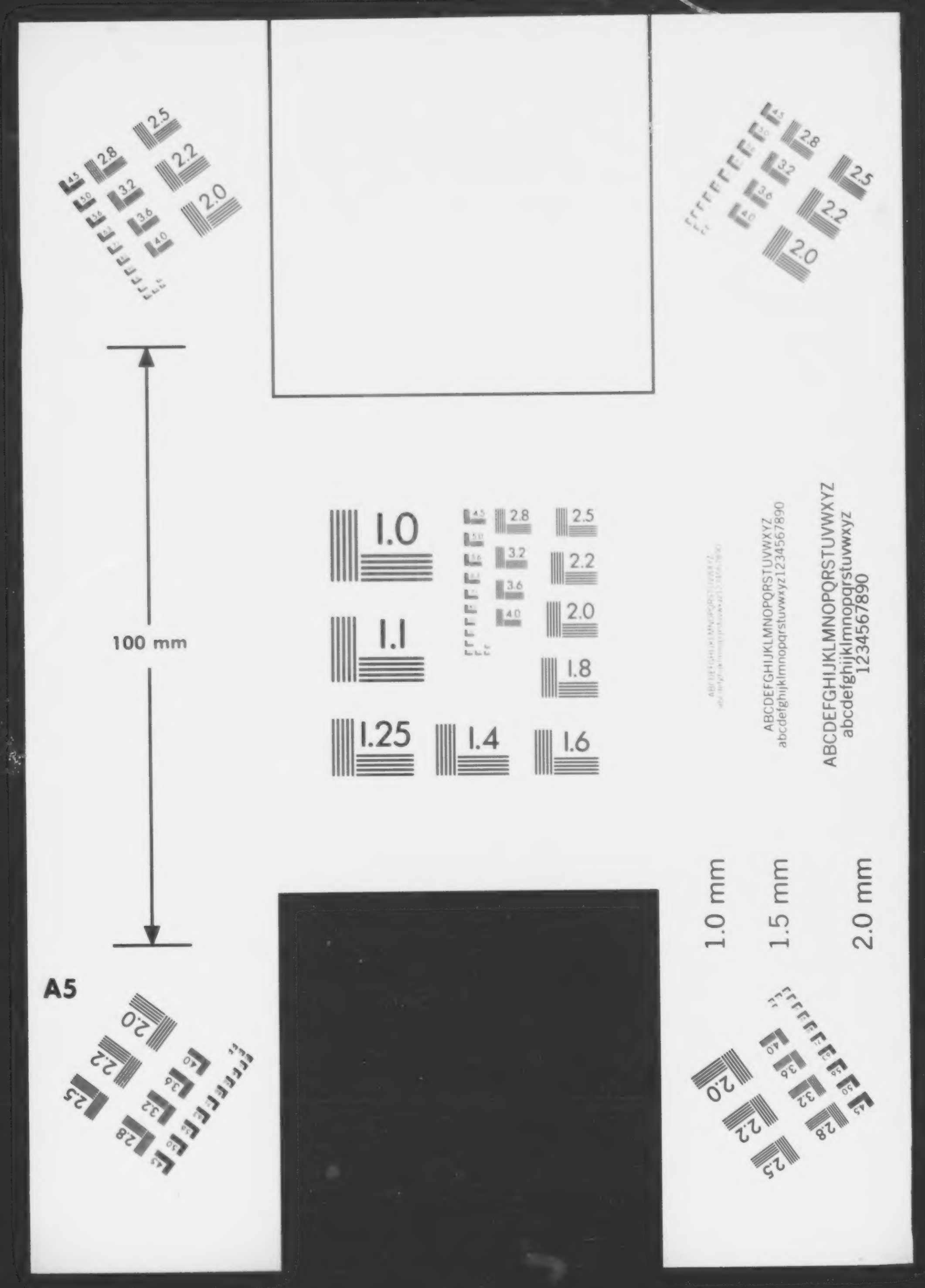
Terrelle J. Wilson Martin Marietta - Denver Aerospace P.O. Box 179 MS: P9682 Denver, CO 80201 Tel: (303) 977-8194	Surface Finish


A5
100 mm
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890
1.0 mm
1.5 mm
2.0 mm

PARAMETER: DIMENSIONAL (CONTINUED)

NEW REQUIREMENTS:

A.) MAP program for calibration of laser systems used on CMM calibrations.
B.) Need better standard/method than ball and socket for SRM.

SPECIAL COMMENTS:

None

PARAMETER: DIMENSIONAL

(Coordinate Measuring Machine)

UNITS: inch or meter

REQUIREMENTS:

1.) MAP program for 48x24x20 size coordinate measuring machine.
2.) Audit service accuracy to +/- 0.0004 inches.
3.) Technical information on coordinate measuring machine calibration.

STATUS at NBS:

1.) No MAP program available for coordinate measuring machines.
2.) NBS has introduced the socketed ball bar as an SRM. The roundness of the balls are certified to be less than 10 uinches. It is estimated that this method is only marginal for the required accuracies of +/- 0.0001 inches.
3.) Technical information on coordinate measuring machines calibration is provided in ASME Standard B89.1.12. The socketed ball bar is described and its use detailed.

A.) Unknown
B.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Communications
3.) Quality Control
4.) Department of Defense

APPLICATION and IMPACT:

1.) Measurement of length parameters on objects of varying size.
2.) Measurement/test of antenna signal output with non-dimensional probe.
3.) Positioning device for various high accuracy, automated projects.

PARAMETER: FORCE

UNITS: Newton, lbf

REQUIREMENTS:

1.) No old requirements.

STATUS at NBS:

A.) Unknown
B.) Unknown
C.) NBS is able to calibrate load cells to 10**6 lbf at +/- 0.01% uncertainty at a standard temperature of 23 degrees C. They are currently developing the capability to measure load cells over a temperature range of 0-40 degrees C (30-110 degrees F) for a load range of up to 200,000 lbf.

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Chemical

APPLICATION and IMPACT:

1.) Obviate the need to dismantle and ship large weights to NBS for re-weighing.
2.) Stamping machines.

NEW REQUIREMENTS:

A.) A transfer standard or set of transfer standards to calibrate the dead weights of load cell calibrating machines would be very desirable. A set of carefully constructed load cells with an accuracy of +/- 50 ppm may serve this purpose.
B.) Dynamic force measurements.
C.) Need load cell with accuracy to 0.01% over a range of 1 - 10**6 lbf and 30 - 120 degrees F.

SPECIAL COMMENTS:

None

PARAMETER: FLATNESS

(Optical)

UNITS: microinches or micrometers (flatness accuracy)

REQUIREMENTS:

1.) No old requirements.

STATUS at NBS:

A.) Present accuracy is +/- 0.000 001 inch (1.uin).

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Machinery
3.) Power
4.) Shipbuilding
5.) Department of Defense

APPLICATION and IMPACT:

1.) Most of the optical flats used today have an uncertainty of +/- 1. uin and these flats are used to calibrate other optical flats that have an uncertainty of +/- 1. uin. The ratio of the uncertainties is only 1:1.

NEW REQUIREMENTS:

A.) Calibration of optical flats from 3 to 12 inches in diameter with uncertainties of +/- 0.25 uin.

SPECIAL COMMENTS:

None

PARAMETER: GLOSS

UNITS: percent transmission

REQUIREMENTS:

1.) No old requirements.

STATUS at NBS:

A.) No calibration services available.
B.) No calibration services available.

INDUSTRIES AFFECTED:

1.) Aerospace

APPLICATION and IMPACT:

1.) Calibration of meters which detect surface glossiness via percent transmission.

NEW REQUIREMENTS:

A.) Traceability to NBS via SRM or calibration service.
B.) Range of 0-100% transmission with accuracy of 0.1%.

SPECIAL COMMENTS:

1.) Gloss standards are available from at least one source (Garner/Hunter Laboratories) who show traceability to an ASTM method of calibration. Gloss is measured as a function of reflectance percent of transmission with respect to angle.

PARAMETER: HARDNESS TESTING

UNITS: Rockwell Scales

REQUIREMENTS:

1.) SRM's for items not tested by micro-hardness methods.

STATUS at NBS:

1.) There are currently no known plans for development of such standards.

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Automotive

APPLICATION and IMPACT:

1.) Hardness testers are common instruments used by metrology and engineering laboratories as well as inspection groups to test the hardness of metals. To date, they have been used more as indicators of the acceptability of parts/materials than a definitive test. With the development of the proposed SRM's more emphasis could be placed on the test results of these instruments.

NEW REQUIREMENTS:

None

SPECIAL COMMENTS:

1.) With the development of the SRM's for micro-hardness a positive step was taken in promoting the importance of hardness testing. However, the job is not yet complete. The micro-hardness testers are primarily used to determine the hardness of thin materials and coatings, whereas the Rockwell and Superficial Rockwell testers are used on raw stock and some finished parts. Due to the difference in application, the proposed SRM's for Rockwell and Superficial Rockwell hardness testers should be developed by the NBS.

PARAMETER: HAZE

UNITS: percent transmission

REQUIREMENTS:

1.) No old requirements.

STATUS at NBS:

A.) No calibration/SRM service available.

INDUSTRIES AFFECTED:

1.) Aerospace

APPLICATION and IMPACT:

1.) Haze meters over a range of 0-100% transmission. Traceability to NBS is required for quantitative evaluation of haze in and around the cockpit of various aircrafts.

NEW REQUIREMENTS:

A.) Haze sample SRM's for verification of haze meters over a range of 0-100% transmission with a +/- 0.1 accuracy.

SPECIAL COMMENTS:

1.) The problem of traceability for haze standards seems to be a unique problem for the aircraft industry. More investigation/inquiry should be made to address applicability.

PARAMETER: HYGROMETRY

UNITS: % relative humidity (R.H.)

REQUIREMENTS:

1.) No old requirements.

STATUS at NBS:

A.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Computer

APPLICATION and IMPACT:

1.) Environmental monitoring.

NEW REQUIREMENTS:

A.) Seminar and literature on techniques, etc.

SPECIAL COMMENTS:

None

PARAMETER: LENGTH (GAGE BLOCK)

UNITS: microinches or micrometers

REQUIREMENTS:

1.) All old requirements are covered.

STATUS at NBS:

A.) Unknown
B.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Automotive
3.) General Manufacturing
4.) Quality Control
5.) Department of Defense

APPLICATION and IMPACT:

1.) Application is for primary length standards, sizing, and quality control.

NEW REQUIREMENTS:

A.) Need higher accuracies for long gage blocks. Current accuracy is stated as +/- 20. uin for 20. inch length. Need accuracies of about +/- 10. uin for same.
B.) Need MAP program for long gage blocks.

SPECIAL COMMENTS:

1.) NBS needs to develop the multiple wavelength interferometry method for direct measurement of long gage blocks with higher accuracy. The long blocks are being used increasingly for calibration and verification of coordinate measuring machines.

PARAMETER: MASS

UNITS: pound (lb) or kilogram (kg)

REQUIREMENTS:

1.) No old requirements.

STATUS at NBS:

A.) Efforts are underway to improve the situation.
B.) Unknown.

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Microelectronics
3.) Nuclear Power

APPLICATION and IMPACT:

1.) Fuel Rods
2.) Sensor Technology

NEW REQUIREMENTS:

A.) Require faster turn-around for calibration service.
B.) Require mass calibration for less than 1 milligram.

SPECIAL COMMENTS:

None

PARAMETER: PARTICLE STANDARDS

UNITS: micrometers or microinches in diameter

REQUIREMENTS:

1.) Spherical Particle SRM's from 0.5 to 1.0 um diameters with accuracies of +/- 5.%.

STATUS at NBS:

1.) Have 0.3 and 0.9 um SRM's made out of polystyrene available with stated uncertainty of 1.%. Glass spherical particle SRM's are now available for 10.um and are expected to be available for 0.1, 3., and 30. um within one year.

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Medical
3.) Micro-Electronics

APPLICATION and IMPACT:

1.) Determination of state of clean and semi clean rooms.
2.) Light and electrical zone flow through counters.

NEW REQUIREMENTS:

None

SPECIAL COMMENTS:

1.) Glass spheres are available for sizes 34-1900 um diameter. These are intended for use in the calibration of test sieves. An adequate range of particle spheres for the calibration linearity check is 0.1 to 30. um.

PARAMETER: SURFACE ROUGHNESS, SURFACE FINISH

UNITS: micrometers or microinches of
surface roughness (Ra) Angstroms

REQUIREMENTS:

1.) None previously identified.

STATUS at NBS:

A.) NBS has SRM's available of 120 +/-3.2 uin (3+/-0.8um).
B.) NBS can certify standard step height specimens to +/- 1.%. NBS can provide manufacturer's information for these specimens upon request. SRM step wafers should be available by Oct. 1986.
C.) Unknown

INDUSTRIES AFFECTED:

1.) Aerospace
2.) Automotive
3.) All Machine Manufacturers
4.) Marine Industry
5.) Semiconductors

APPLICATION and IMPACT:

1.) Surface Finish on critical surfaces.

NEW REQUIREMENTS:

A.) Need to verify linearity of multi-range analog and digital profilometers from 10 uin (0.25um) to 2000 uin (50 um).
B.) Need to verify roughness across the same range.
C.) Standard reference materials for Angstrom range. These would be applicable to "non-contact" surface measurements in the following ranges:

100 - 500 Angstrom
500 - 1,000 Angstrom
1000 - 10,000 Angstrom

PARAMETER: SURFACE ROUGHNESS, SURFACE FINISH (CONTINUED)

SPECIAL COMMENTS:

1.) Although Step Height Specimens are available over a variety of range requirements and these specimens are reputed to work with the stylus type of profilometer, a Step provides a one point change. While this can be accurately measured with a hard copy (plotter/recorder) readout device, it presents problems with a direct reading (analog or digital) device. Even when these units have a recorder output this does not ensure the correct operation of the metering circuit.
2.) The SRM step wafers are primarily being provided to meet the needs of the Semiconductor Industry. These wafers are designed specifically for optical roughness verifications and will be unsuitable for use as stylus roughness standards.
3.) Diamond tipped stylus measurements have proved to be unsatisfactory for surfaces specified to better than 20 uin (0.5um). Although some stylus systems are capable of measuring to this level, damage to the surface requiring this level of finish has been noted and attributed to the stylus.

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NBSIR84-2847, March 1984

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NBS Special Publication 705, 1985

[5] Update of NBS Response NCSL National Measurement Requirements Survey
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DC/LF Electrical Measurements

[6] Update of NBS Response NCSL National Measurement Requirements Survey
August 1, 1986
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George A. Uriano, NBS Representative

[7] NBS Calibration Services Users Guide 1986-88
NBS Special Publication 250
George Uriano, Ernest L. Garner, R. Keith Kirby, William P. Reed, Editors
Available from: Superintendent of Documents
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NBS Special Publication 260
R. W. Seward, Editor
Available from : Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

[9] NBS Update, National Bureau of Standards
March 23, 1987

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May 5, 1987

Dr. Ronald L. Kerber
Deputy Under Secretary of
Defense for Research and Advanced Technology
Department of Defense
Washington, DC 20301

Dear Dr. Kerber:

On behalf of the Subcommittee on Science, Research and Technology, I would like to thank you for appearing as a witness on the semiconductor panel during the Subcommittee's hearings on "The Role of Science and Technology in Competitiveness".

In order to have as complete a record as possible, we would appreciate your prompt response to the enclosed additional questions for the record.

Thank you again for your excellent testimony.

Sincerely,

Doug Walgren

DOUG WALGREN, Chairman
Subcommittee on Science,
Research and Technology

DW/Pll
Enclosure

SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
"Competitiveness"

April 29, 1987

QUESTIONS FOR THE RECORD

Dr. Kerber
Deputy Under Secretary of Defense for Research and Advanced Technology

1. Could a reorganization of the federal government's industrial research and development efforts (such as creation of a Department of Science and Technology) be responsive to the semiconductor industry's needs as well as other industries' needs?

2. Have current federal resources (i.e. National laboratories, National Bureau of Standards, NSF engineering centers, etc.) been responsive to the semiconductor industry's needs? Please comment on which federal resources have served the industry and which haven't.

3. Will funding a proposal like Sematech merely delay the "structural" changes or industry realignment some experts feel must take place in order for the semiconductor industry to become competitive?

4. Are we merely addressing the symptoms of the semiconductor industry's problem rather than its true causes? What lies at the base of the problems - is it a need to restructure the federal role, or is there a need for the industry to restructure?

INSERT FOR THE RECORD

☐	HOUSE	APPROPRIATIONS COMMITTEE	☐	HOUSE	ARMED SERVICES COMMITTEE	☐	HOUSE	OTHER Science Space and Technology
☐	SENATE		☐	SENATE		☐	SENATE	

HEARING DATE April 29, 1987	TRANSCRIPT PAGE NO.	LINE NO.	INSERT NO. Q-1	

Reorganization of Government R&D

Question: Could a reorganization of the Federal Government's industrial research and development efforts (such as creation of a Department of Science and Technology) be responsive to the semiconductor industry's needs as well as other industries' needs?

Answer: The loss of technological leadership of U.S. industries is the symptom of a much more complex international competitiveness problem. It is not clear, at this time, that a reorganization of Federal Government's industrial research and development efforts would contribute significantly to resolving this problem. Since the causes of the problem involves more issues than just science and technology, the creation of a Department of Science and Technology would probably have little impact on future competitiveness for either the semiconductor industry or other industries. In addition, our defense strategy relies very strongly on superiority in certain key technologies. Any restructuring that resulted in a weakening of the support by DoD of technologies that are needed to assure national security could be disastrous.

INSERT FOR THE RECORD

☐	HOUSE	APPROPRIATIONS COMMITTEE	☐	HOUSE	ARMED SERVICES COMMITTEE	☐	HOUSE	OTHER Science Space and Technology
☐	SENATE		☐	SENATE		☐	SENATE	

HEARING DATE April 29, 1987	TRANSCRIPT PAGE NO.	LINE NO.	INSERT NO. Q-2	

Responsiveness of Federal Resources to Industry Needs

Question: Have current federal resources (i.e. National Laboratories, National Bureau of Standards, NSF engineering centers, etc.) been responsive to the semiconductor industry's needs? Please comment on which federal resources have served the industry and which haven't.

Answer: The Federal Government has not typically funded research and development specifically for the purpose of serving industry. Our science and technology programs supplement and complement industry efforts where these efforts do not respond to broader federal needs (i.e. national security, energy, etc.). Much of the work undertaken by the Federal Government is performed in industry and forms a basis of highly skilled expertise that can be used for commercial or industrial purposes. There have been many examples of technical spin-offs to industry from work performed in our federal laboratories and engineering centers. A recently signed Executive Order specifically addresses the needs to enhance the mechanisms by which our federal resources interact with industry.

INSERT FOR THE RECORD

☐	HOUSE	APPROPRIATIONS COMMITTEE	☐	HOUSE	ARMED SERVICES COMMITTEE	☐	HOUSE	OTHER Science Space and Technology
☐	SENATE		☐	SENATE		☐	SENATE	
HEARING DATE April 29, 1987		TRANSCRIPT PAGE NO.		LINE NO.		INSERT NO. O-3		

Funding for SEMATECH

Question: Will funding a proposal like SEMATECH merely delay the "structural" changes or industry realignment some experts feel must take place in order for the semiconductor industry to become competitive?

Answer: At this time it is difficult to provide a definitive answer given that the details of the SEMATECH proposal are still being formulated and discussed within industry and the government.

INSERT FOR THE RECORD

☐	HOUSE	APPROPRIATIONS COMMITTEE	☐	HOUSE	ARMED SERVICES COMMITTEE	☐	HOUSE	OTHER Science Space and Technology
☐	SENATE		☐	SENATE		☐	SENATE	

HEARING DATE April 29, 1987	TRANSCRIPT PAGE NO.	LINE NO.	INSERT NO. Q-4	

The Base of the Semiconductor Industry Problem

Question: Are we merely addressing the symptoms of the semiconductor industry's problem rather than its true causes? What lies at the base of the problems - is it a need to restructure the federal role, or is there a need for the industry to restructure?

Answer: The Defense Science Board and other assemblies of experts have ascribed similar, complex causes for the semiconductor industry problem ranging from technological leadership to industrial structural differences. We are currently working within the Administration to determine if any coordinated federal actions should be taken. It has not been determined that restructuring the federal role will resolve the problem. Clearly the fate of the industry lies mostly from within.

NSBU
NATIONAL SMALL BUSINESS UNITED
"Serving America's small businesses since 1937"

June 26, 1987

Representative Doug Walgren
U.S. House of Representatives
Washington, DC 20515

Dear Representative Walgren:

National Small Business United (NSBU) is a new national trade association formed from the recent merger of the National Small Business Association, a multi-industry trade association founded in 1937, with Small Business United, a coalition of regional, state, and metropolitan small business associations organized in 1981. NSBU represents over 50,000 small businesses nationwide.

NSBU wholeheartedly supports your initiative in cosponsoring H.R. 2492, the Federal Industrial Extension Act of 1987, which would assist small businesses by giving them access to technological research.

It has been estimated that over $100 billion has been allocated to Federal laboratories by Congress over the past ten years for research and development. A program to facilitate and accelerate the transfer of technology from government laboratories to the business community is essential to our economy. It will bring the small business community into the mainstream of stimulating the economy by creating the new products and new jobs.

A program, such as your legislation proposes, is long overdue. On behalf of the members of National Small Business United, we wish to express our appreciation for your leadership in advancing such a worthwhile cause.

Sincerely,

Tom Cator

G. Thomas Cator
Legislative Counsel

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July 28, 1987

The Honorable Doug Walgren
Chairman
Subcommittee on Science,
Research and Technology
2321 Rayburn House Office Building
Washington, DC 20515

Dear Doug:

Thank you for your recent letter concerning possible amendments to the Bayh-Dole Act. I appreciate very much the cooperative working relationship which has developed on this issue.

Unfortunately, with respect to the particular issue you raise -- inclusion of government owned, contractor operated (GOCO's) in the Act -- I must demur. While I can easily understand the interest of you and other members of your Committee on Science and Technology in this issue it does appear to require greater legislative scrunity.

I would be glad to work with you to craft a separate bill which would accomplish the goal you seek. Hopefully through such a legislative vehicle, we will be able to give this issue the attention it deserves. Once such a bill is introduced, I will be happy to work with you to schedule a hearing on the matter.

Thank you again for your thoughtfulness.

With warm regards,

Sincerely,

Bob

ROBERT W. KASTENMEIER
Chairman
Subcommittee on Courts,
Civil Liberties and the
Administration of Justice

RWK:dbv